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The Registered Office and Laboratories of the B.C.I.R.A. at:—

21-23, ST. PAUL'S SQUARE, BIRMINGHAM

Telephone: Central 1885. *Telegrams: CIRA*

The B.C.I.R.A. Scottish Laboratories are:—

Foundry Technical Institute, Meek's Road, Falkirk (*Telephone* 332)

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Metallurgical Rivalries

In these days of mass publicity and boost it is by no means an uncommon practice for interested parties to go upon the house tops and cry the virtues of their wares. The deafening uproar of propaganda which results is an institution which we have come to regard as inevitable and to bear with what patience we can muster, but when this practice tends to become a feature of responsible technical discussions the situation assumes a more serious aspect. We refer to the noticeable tendency for the most recent developments to be hailed by their sponsors as the solution to all the problems of engineering production and the veritable elixir of metallurgical life. When, for instance, two or three welding experts are gathered together in conference it is not uncommon to hear ponderous pronouncements being made envisaging the rapid decline and eventual closing down of the nation's ironfoundries; machines and structures will henceforward be fabricated entirely by the welding of rolled sheets and sections, and so forth. In the same way the plastic moulding industry has been responsible for some similarly exaggerated forecasts in respect of the non-ferrous side of the foundry industry, while the advocates of steel pressings have been by no means guiltless in this respect. The new is always about to oust the old.

Now progress in the metallurgical and engineering industries, as in any other sphere of activity, depends upon venturing into new fields and striving for something in advance of present practice, but it is usually found that the only true and stable advances are due to an integration of small changes rather than to any revolutionary upheaval in technique. Efforts are constantly being made to improve existing materials and to devise alloys of enhanced properties, while developments in large-scale production have focussed attention on the possibilities of economies in process materials, equipment and labour in the foundry industry. As a result of this concentration of effort in the direction of better and cheaper castings, it is found that there is still a balance of power between rival methods and materials when all the complex economic factors are taken into consideration. Each has a definite field of usefulness, and attempts at the unwarranted invasion of territory which, for both technical and economic reasons, is the logical preserve of a rival material or process merely serve to display the ignorance of those responsible for them.

We are not referring, of course, to legitimate advertising and development work, but to the barrage of propaganda and special pleading which is maintained by otherwise responsible technical people. These overweening claims for supremacy are as irritating as they are ill-advised. As engineering methods change and develop so inevitably will the demands of the engineering industry fluctuate between the several alternative means of achieving a particular end. Mutual encroachment must and will occur as circumstances change, but there will be ample room in the future for all the methods and materials that the metallurgical industries can offer.

Trade Prospects

The turn of the year offers a convenient opportunity to consider trade prospects. It is well known that conditions in this country have been for some time a great improvement on those in other countries, particularly where political conditions are less stable. However, even here there are some misgivings as to the future of trade in the country. There are three views taken in discussion with those whose contacts and experience entitles them to respect. Firstly, some anticipate a setback. These people think that we have done well because, as suggested above, we are politically stable and have protected our home market, which has inspired confidence in those spending both capital and income. They say that the home market is becoming saturated and that our temporary advantage gained by giving off the gold standard is going. The recent employment returns rather tend to support this view, showing as they do slight increases in unemployment. The second group thinks that no setback need be experienced provided international trade improves, a recovery largely dependent again on politics. The third group thinks that we can go on expanding entirely on our home market provided courageous measures are taken at home, such as the slum-clearance plan. The Federation of British Industries Trade Forecast for the third quarter suggests that British trade is back to normal and that further recovery depends upon the international situation, thus inclining to the second opinion. The absorption of those thrown out by the slump has been remarkable, amounting to 75 to 80 per cent. in the motor and iron and steel trades.

(*Concluded on page* 106.)

Round Tensile Bars for Cast Iron

By A. C. Vivian, Assoc.M.Inst.C.E.

Introduction

The influence of alterations in the relative dimensions of turned bars for tensile tests on cast iron is illustrated in the following article with the aid of sheet-rubber models.

The tensile testing of cast iron is required to determine the elastic character. This is sometimes denoted by an R/T ratio (where R = transverse rupture stress—or modulus of rupture—and T = tensile strength); or, in the method of stress computation developed by the writer by a factor called the form factor.[1] The stress developed on the tension face of a C.I. beam at fracture is the same as the ultimate tensile strength of the iron measured on direct test. The test results referred to show that formulæ can be written down for the maximum moment of resistance of beams of rectangular, round, tee and other cross-sections in terms of the form factor and the ultimate tensile strength.

It follows that when testing cast iron of a particular grade produced under controlled and similar casting conditions, it is not necessary to make both tensile and transverse tests once the elastic character has been determined.

Unless considerable care is exercised in designing the shape of the tensile test-bars employed, the apparent strength obtained may be in error, not because of any fault in the material, but due to faults in the shape of the test-bars used.

Test results frequently show big differences in tensile strength as between bars of varying size. By no means the whole of the variation in strength is attributable to weaker metal at the centre of a bar; an appreciable proportion is due, in the writer's opinion, to neglect of the principle of geometrical similarity.

In the case of a number of grades of cast iron which are classed (when compared, for example, with mild steel or malleable iron) as brittle materials, it is essential to employ geometrically similar tensile test-bars if true comparisons are to be obtained between thick and thin sections.

It is shown by means of rubber models how the shape of the gripped ends has an influence on the apparent tensile strength obtained. That a bar must be reduced in diameter at the middle relative to the gripped ends is generally recognised. The amount of the reduction may have a vital influence on the tensile strength obtained.

Whether or no a parallel length in the reduced section is essential has been a controversial matter. The conclusion is drawn from the experiments now described that a parallel portion in the reduced section is important.

Description of Tests

The stretching machine used was of simple construction and has been previously described.[2]

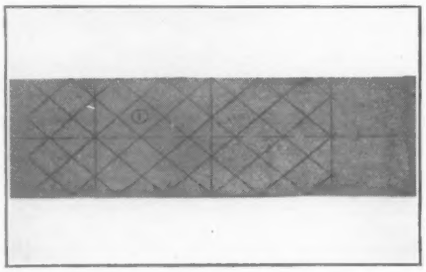


Fig. 1.—Stress-Strain Relation and Poisson's Ratio (Model 1).

The sections tested were cut from red rubber sheet approximately 0.016 in. thick, to represent longitudinal sections of various round tensile bars. Grips were simulated by stiff glued paper, which did not distort under the loads applied to the rubber models.

The following investigations were made:—

(*a*) *Stress-Strain Relation and Poisson's Ratio.*—Fig. 1 shows a photograph of the model which consisted of rubber sheet 3 in. wide by 13 in. long with grips placed across the ends. Measurements of longitudinal stretch and lateral decrease were made for increasing loads after the very slight plastic yield had been separated out by an initial loading. The results obtained are plotted in Fig. 2, on which are also tabulated the values of Poisson's Ratio, *i.e.*, the ratio of the strain in the direction of width to the simultaneous strain in the direction of length. The values given are the ratios of the average strains from zero to the loads stated.

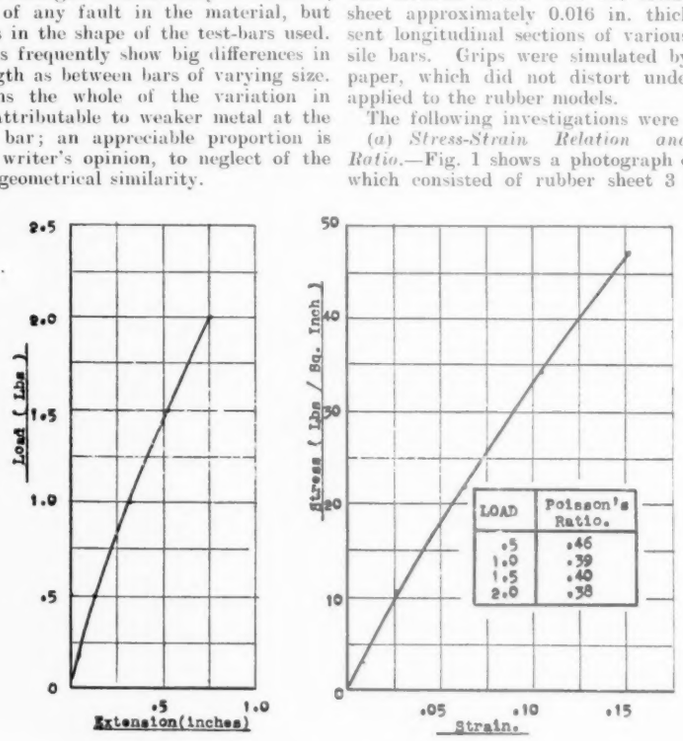


Fig. 2.—Load-Extension and Stress-Strain Graphs.

The relation between the load and extension has been plotted, and also the relation between stress and strain, the stress being obtained by dividing the load by the reduced cross-section. The reduction in thickness was assumed to be proportional to the reduction in width.

It will be noted that the load-extension and the stress-strain relations are similar in character to those of cast iron, *i.e.*, there is a slight curvature, the modulus of elasticity decreasing as the load increases in the same way as for cast iron. Poisson's Ratio for the rubber sheet is greater than for cast iron, so that rubber models of C.I. tensile bars exaggerate somewhat the effects of lateral decrease in diameter.

The rubber models exaggerate also in that the cross-section of a round bar varies as the square of the diameter and the rubber model simply as the width (*i.e.*, diameter). Keeping these exaggerations in mind, reasoning based on the following qualitative results can be applied to round bars.

(*b*) *Effect of Altering Length of Gripped Ends.*—Model No. 2 was a full-size model of a longitudinal half-section of the standard L-bar of B.S.I. Specification No. 321, having a diameter in the gauge length of 1.785 in. and with gripped ends D the minimum of 1 in. permitted.

Model No. 3 was similar to No. 2 except that the gripped length was made 3 in. An equal load was applied in each case. The load was proportional to the maximum load applied to Model No. 1 in the ratios of their respective widths, *i.e.*, 1.785 : 3. The models under load are shown in Fig. 3.

The beneficial effect of an increase in the gripped length was very clearly marked in the models and is discernible in the photographs reproduced. It is evident that as the length gripped relative to the gripped diameter (which may conveniently be termed the grip ratio) is increased, the distortion of the inside of a bar relative to its outside surface is lessened. The grip ratio of Model No. 3 was 3/2.2 = 1.36, and No. 2 was 1/2.2 = 0.45. Unless the grip ratio of C.I. bars of different sizes is constant, reliance cannot always be placed on the relative values of tensile strength obtained from various sizes of bars.

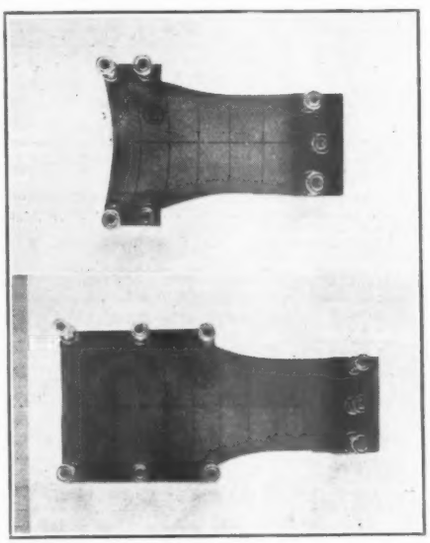


Fig. 3.—Effect of Altering Length of Gripped Ends (Models 2 and 3).

(*c*) *Effect of Reduction in Diameter.*—Model No. 4 was a parallel-sided bar 1.6 in. wide by 10 in. long overall, having gripped ends 2 in. long and a grip ratio of 2/1.6 = 1.25. Model No. 5 was similar to No. 4 except that it had enlarged ends so that the gripped diameter was

1 "Analysis of B.C.I.R.A. Tests by the Form-Factor Method." Foundry Trade Journal, March 16, 1933.

2 "The Influence of Shape in Tensile Test-Bars." Foundry Trade Journal, January 28, 1932.

2.5 in. and the grip ratio therefore 2/2.5 = 0.80. Fig. 4 shows photographs of the two models under equal load proportional to the previous loads in the ratio of widths of reduced section.

A very high stress is induced in the outside edges of the parallel-sided model where the edges are secured to the grips. This high stress is

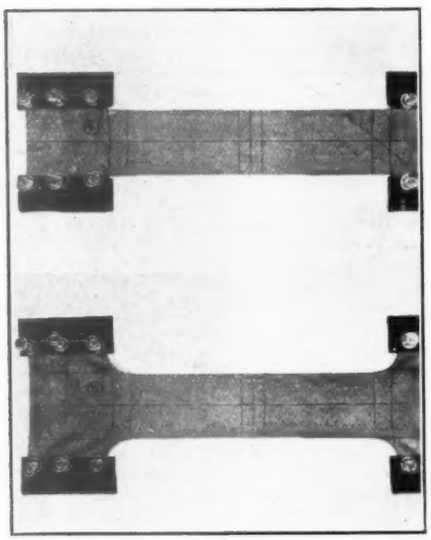


Fig. 4.—Effect of Reduction in Diameter (Models 4 and 5).

much reduced by enlarging the ends as shown in Model 5, and it is evident that, although the grip ratio is smaller in Model No. 5 than in 4, a cast-iron bar with the proportions of Model No. 5 would withstand a higher load before fracture than a parallel-sided bar such as is represented by Model No. 4.

The skin of an "as-cast" bar is stronger than the inside metal. A parallel-sided bar

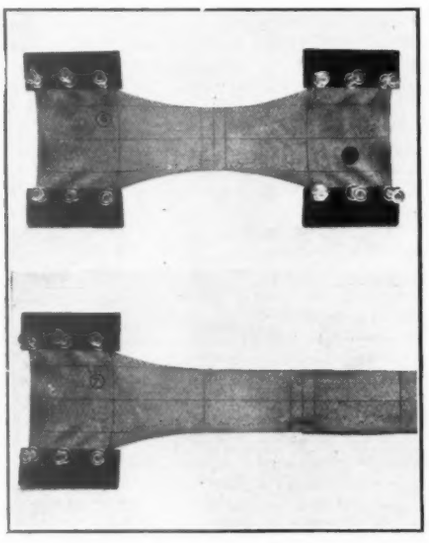


Fig. 5.—Effect of a Parallel Gauge Length (Models 6 and 7).

would nevertheless show a lower tensile strength than a bar with its diameter reduced between the grips. Anomalous results will be obtained on C.I. bars in tension unless a constant ratio is maintained between the grip diameter and the diameter of the reduced section.

(*d*) *Effect of a Parallel Gauge Length.*—Model No. 6 was a scale model double full size of the M-bar of B.S.I. Specification No. 321, except that the parallel length was omitted. Model No. 7 was a double full-size model of the M-bar. The grip ratio was therefore in each case identical with that of the M-bar (of minimum specified grip length, D), namely, 1/1.2 = 0.83. Fig. 5 shows the two models each loaded to the same amount as Models 4 and 5.

The beneficial effect of the parallel gauge length was very apparent in the models, and may be noted in the illustrations. At the middle of each model parallel transverse lines were drawn ½ in. apart before applying the load. In the Model No. 6 without parallel gauge length there was, after loading, a perceptible curvature of the lines, being wider apart at the edges than at the centre. This indicates that there would be a higher stress along the edges (or along the surface in the case of a round bar) than along the inside. In the case of the parallel-sided model there was no apparent curvature on the middle ½-in. gauge lines, but some curvature was apparent in the transverse lines where the width begins to increase at the fillets. This difference in length between outside and inside denoted by the curvature is averaged over the parallel length to obtain the difference in stress between outside and inside.

It follows that the stress difference between outside and inside of a bar with a parallel gauge length, Model 7, will be less than that of a bar without parallel gauge length, but similar otherwise, such as is represented by Model 6.

(*e*) *Effect of Double Reduction in Diameter.*—Model No. 8 is based on a combination of the M-bar and the S-bar of British Standard Specification No. 321. The grip ratio is 1/1.2 = 0.83, but a reduced diameter part has been introduced between the gripped part and the fillet so that the effective grip ratio is really greater.

The gauge diameter is in the same proportion to the gripped diameter as 0.564 in. (S-bar gauge dia.) is to 1.2 in. (M-bar grip dia.). The actual dimensions of the gauge width of the model is 1.6 in. (all dimensions being increased proportionately), and the same load was applied as to the previous bars of equal gauge width. The model is shown stretched in Fig. 6.

There is very little distortion. It was, however, possible to see a slight curvature in the lines spaced ½ in. apart at the middle of the bar. This denotes a slight non-uniformity of stress, which would be reduced as Test (*d*) shows by introducing a parallel gauge length. Still closer approach to uniformity of stress distribution at the gauge diameter would be attained, as Test (*b*) indicates, by lengthening the gripped ends, *i.e.*, increasing the grip ratio.

In general, Test (*e*) suggests that a beneficial result is attained by introducing into a turned bar for tensile tests a double reduction in diameter between gripped and gauge parts.

Deductions

Deductions drawn from an examination of test results are supported by the qualitative tests on rubber models now described, and are that for any grade of cast iron devoid of appreciable plasticity, the shape of a turned bar should have the relative dimensions shown in Fig. 7. Actual dimensions are also stated in the figure for bars having cross-sectional areas at the gauge diameter of ¼, ½, 1 and 1/50 sq. in.

With any geometrically similar bar of the proportions stated, it should be possible to obtain the true tensile strength and tensile stress-strain relation (on a 1-in. gauge length).

Method of Gripping

The disadvantage of the bar recommended is its length. The length eliminates "shear effect," *i.e.*, distortion of the inside of a bar relative to the outside, but may occasion greater error due to non-axial loading.

If limited to determination of elastic character, the tensile test would only be required infrequently, and particular care to ensure truly axial loading and the elimination of bending stresses would be justified. The bars proposed in Fig. 7 are designed either with plain ends for wedge grips or with threaded ends for screwed grips. An alternative method of gripping, which has much to recommend it, is the collar grip.

Reduction in Diameter

As the outside of a bar is generally stronger than the inside, there is a limiting diameter below which the advantage of cutting deeper into the metal at the reduced section to eliminate shear effect will be more than counterbalanced by the reduced strength of the inside metal.

To determine whether a particular grade of iron weakens considerably at the centre of a bar, two sets of tensile bars should be cast. For example, one or more of the ¼-sq. in. bars, Fig. 7, would be cast about 1.25 in. dia. parallel

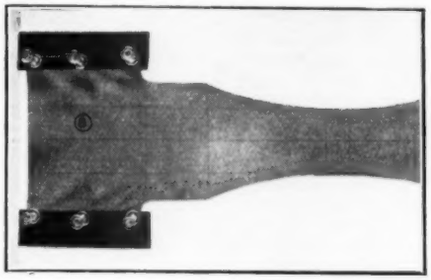
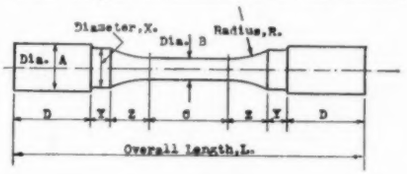


Fig. 6.—Effect of Double Reduction in Diameter (Model 8).

by 9 in. long and machined to the stated dimensions. One or more bars would also be cast to shape (with some addition to the diameters "as-cast" to permit machining, if required). Irons which do not weaken much at the centre of thicknesses up to 1¼ in. would yield approximately the same values of tensile strength on the two types of bar. Reductions in strength of thick bars are, however, more conveniently assessed by calculation from bending tests, assuming constant elastic character for any particular grade of iron cast under similar conditions.

Conclusion

The dimensions proposed for tensile test-bars are devised for irons with practically no plasticity. For irons with appreciable plasticity the extra length recommended is not essential



		Proportional dimensions	Test Cross-Section. ¼ sq. in	½ sq. in	1 sq. in	1/50 sq. in
Dimension	A	2.127	1.20	1.70	2.40	.34
"	B	1.000	.564	.798	1.128	.160
"	C	3.546	2.00	2.83	4.00	.57
"	D	3.546	2.00	2.83	4.00	.57
"	X	1.773	1.00	1.42	2.00	.28
"	Y	.887	.50	.71	1.00	.14
"	Z	1.773	1.00	1.42	2.00	.28
"	R	4.258	2.40	3.40	4.80	.68
"	L	15.960	9.00	12.75	18.00	2.55

Fig. 7.—Geometrically Similar Bars.

for tensile-strength determinations. If a short, thick tensile bar yields a high tensile figure, the high value indicates that the iron tested possesses considerable plasticity as well as strength, and with such an iron no difference will be recorded whether the gripped ends are long or short or whether the parallel length be omitted or not.

(*Concluded on page* 112.)

XUM

Production of Alloy Steel Castings*

By A. W. Gregg

Production of alloy steel castings in the United States has shown a remarkable increase during the past 14 years. In 1918, the tonnage of alloy steel castings was 4.7 per cent. of the total tonnage of steel castings produced and in 1931 (the last year for which accurate figures are available) the tonnage of alloy castings was 17.4 per cent. of the total tonnage of castings. In only four of the 14 years was the percentage of alloy castings smaller than in the preceding year.

The introduction of alloys into steel castings has widened their field of application, because properly-made alloy castings possess physical properties which have permitted them to encroach upon the territory held for many years by forged and rolled products. Alloy castings have enabled the designing engineer to reduce sections and weights of moving parts without sacrifice of strength, and they have increased many-fold the length of service obtained from parts subject to wear, abrasion and shock.

Another field where the introduction of alloys has created new applications for castings lies in those industries where castings are subject to heat-corrosion and acid attack. This problem has been solved by use of high percentages of chromium and nickel sufficient to produce austenitic structures.

The present Paper is confined to a discussion of the production of the pearlitic and sorbitic classes of alloy castings. In this division, the reasons for the introduction of alloying elements usually will group themselves under one or more of the following heads: (1) Increased strength for a given ductility; (2) increased ductility for a given strength; (3) increased resistance to wear and abrasion, and (4) increased toughness to withstand shock.

It is possible to produce castings of sufficient tensile strength for most casting applications by increasing the carbon content and by quenching and tempering. However, with ordinary carbon steel the brittleness and lack of ductility which accompanies increased tensile strength beyond about 45 tons per sq. in., is of sufficient detriment to warrant the extra expense of an alloy addition. The converse of this argument is that carbon steel, sufficiently ductile for most any application, can be produced by proper heat-treatment and a low carbon content, but it is possible with alloy additions to equal the ductility of the carbon steel and at the same time practically double its strength.

The same possibilities exist in designing steels for shock or wear resistance. In every casting application, it is important to determine the most favourable compromise between toughness and strength. This, together with a consideration of the cost factor, should permit a decision as to the kind of alloy steel and kind of heat-treatment best adapted to the job in question.

Alloys in greatest favour for the production of the pearlitic and sorbitic classes of castings are: (1) Nickel, (2) chromium, (3) molybdenum, (4) vanadium and (5) manganese. Various combinations of these alloys result in a surprisingly large number of alloy steels adaptable to castings, and any foundry in the general jobbing business is obliged to cater to many different preferences and prejudices of designing engineers and metallurgists.

Table I shows a representative list of 15 alloy steels regularly manufactured for castings in the United States. The significant portion of the chemical composition, the physical properties which can be produced, and the heat-treatment applied, are shown. Some of the steels listed are manufactured regularly in the foundry in which the author is employed, and the others are produced with equal facility by reputable concerns with which he is acquainted. The physical properties shown for steels made by the author's company were determined in its laboratories. The properties of the others were obtained in most cases from the advertising literature published by the manufacturer. So far as possible, physical properties have been given for each steel mentioned in both the normalised and the quenched and drawn conditions. The figures represent average properties rather than minimum, and in the majority of cases are for steels of machinable hardness.

Unusual physical properties can be attained with 0.30 carbon heat-treated steel, if the same careful practice necessary for alloy casting production is followed. Careful furnace manipulation, freedom from aluminium and heat-treating as indicated in the figure will produce physical properties in carbon-steel castings which are equal or superior to those shown by many carelessly-made and indifferently heat-treated alloy steel castings.

The most important difference in the shop practice for the production of alloy steel as compared to carbon steel consists in greater attention to detail in every department of the foundry. The same difficulties which occur in producing acceptable castings of carbon steel are intensified in producing alloy-steel castings. With most alloy steels there is a greater tendency for both hot and cold cracks, shrink holes and porosity. Moulding sands must be selected, mixed and rammed carefully. Baking temperatures and time of baking should be controlled by recording pyrometers. Painstaking melting-furnace manipulation and control of pouring temperatures are of vital importance. Heat-treating, if not properly performed, may do more harm than good. Heat-treating furnaces require good insulation and automatic temperature control. Provision for rapid handling of hot loads from furnace to quenching tank is essential. Every department in the foundry will find that the production of alloy castings has introduced new problems which must be solved if a satisfactory product is to be produced.

Acid Melting Practice

The electric arc furnace is the most generally-used melting unit for the manufacture of alloy castings, and in the United States the large majority of furnaces are acid-lined. The charge should consist of clean, carefully-selected scrap. Phosphorus and sulphur contents should be well below 0.04 per cent., and economy of operation dictates that the carbon content in the metal as melted should be not much over 0.25 per cent. Sufficient ore should be charged with the scrap or added when the metal is melted to produce a highly-oxidised slag, because it is necessary to produce a good lasting boil characterised by one or more periods of violent ebullition and a copious evolution of carbon monoxide.

When the bath has quieted down to a mere ripple, a test sample should be cooled and broken and the melter's judgment of the carbon content should be verified in the laboratory. If the carbon be too high, more ore must be added and the boiling cycle repeated.

At this point a new slag should be built up by additions of sand, broken brickbats and limestone in approximately equal proportions. When this new slag has melted thoroughly, a sample removed from the furnace should be a shiny

TABLE I.—*Properties of Some Pearlitic Alloy Cast Steels.*

Type.	Analysis.	Ultimate strength. Tons per sq. in.	Yield point. Tons per sq. in.	Elongation. Per cent.	Reduction of area. Per cent.	Brinell No.	Izod, ft.-lb.	Treatment deg. C.
1. Nickel Steel	C—0.25 Ni—3.50	45	31	24.0	32.0	—	—	W.Q. 899 T. 677
	C—0.35 Ni—3.00	42.5	29	13.0	22.0	230	—	N. 816 T. 593
2. Chromium Steel	C—0.36 Cr—3.00	66	49	10.0	29.9	280	—	O.Q. 899 T. 593
	C—0.35 Cr—0.77	43.5	25	17.5	26.0	217	—	N. 899 T. 677
3. Molybdenum Steel	C—0.26 Mo—0.61	43.8	33.6	24.5	58.0	197	—	W.Q. 871 T. 705
	C—0.26 Mo—0.61	38.5	27.4	27.0	60.0	170	—	N. 871 T. 705
4. Manganese Molybdenum	C—0.30 Mn—1.20 Mo—0.20	44.8	36	21.0	50.0	205	52.0	W.Q. 871 T. 677
		37.5	26.8	27.0	55.0	165	—	N. 871 T. 705
5. Chrome Molybdenum	C—0.30 Cr—0.80 Mo—0.20	50	42	18.0	50.0	203	—	W.Q. 843 T. 677
		49	36	20.0	40.0	210	—	N. 843 T. 677
6. Nickel Chrome Molybdenum	C—0.30 Cr—0.80/90 Ni—2.00 Mo—0.25	51.5	41	20.0	50.0	230	42.0	W.Q. 871 T. 677
		51	40	21.0	50.0	240	—	N. 899 T. 650
7. Chromium Manganese Molybdenum	C—0.34 Cr—0.96 Mn—1.19 Mo—0.34	51.8	37	21.0	55.0	227	—	W.Q. 871 T. 705
		47	34.5	23.0	55.0	207	—	N. 871 T. 705

* Extracted from the American Foundrymen's Association Exchange Paper presented before the 10th Annual Meeting of the Bureau of Steel Manufacturers, of Australia. The Author is General Superintendent, Bonney-Floyd Company, Columbo, Ohio.

Table I (*continued*).—*Properties of Some Pearlitic Alloy Cast Steels.*

Type.	Analysis.	Ultimate strength. Tons per sq. in.	Yield point. Tons per sq. in.	Elongation. Per cent.	Reduction of area. Per cent.	Brinell No.	Izod, ft.-lb.	Treatment deg. C.
8. Nickel Molybdenum	C—0.30 Ni—1.50 Mo—0.30	40	26.8	22.0	45.0	—	—	N. 871 T. 650
9. Nickel Chrome	C—0.30 Cr—0.90 Ni—2.00	50.5	41.5	20.0	55.0	229	—	W.Q. 843 T. 677
		49	33.5	20.0	40.0	210	—	N. 843
10. Nickel Vanadium	C—0.20–0.30 Ni—1.50–1.75 V—0.12–0.15	38 to 42.5	24.5 to 29	22.0 to 25.0	45.0 to 50.0	— — —	— — —	Normalised and tempered. Temperatures not given.
11. Nickel Chromium Manganese Molybdenum	C—0.35 Ni—1.50 Mn—1.25 Cr—0.90 Mo—0.30	61.5	53	16.0	45.0	302	—	N. 899 T. 593
12. Chrome Vanadium	C—0.30 Cr—1.00 V—0.10	42	29	27.5	57.0	—	50	O.Q. 871 T. 705
13. Manganese Vanadium	C—0.35 Mn—1.40 V—0.10	46.5	35.5	27.0	54.0	—	49	Double normalised and tempered. Temperatures not given.
14. Nickel Manganese	C—0.30 Mn—1.44 Ni—2.30	51	28.6	15.7	25.5	—	—	W.Q. 899 T. 677
	C—0.30 Ni—1.00	38 to 47	24.5 to 29	22.0 25.0	45.0 50.0	175 185	40.0 45.0	N. 899 T. 650
15. Pearlitic	C—0.35 Mn—1.25	38 to 45	22.5 to 26.8	18.0 to 22.0	40.0 to 50.0	160 to 200	15.0 to 25.0	Normalised temperatures not given.

W.Q. = Water Quenched; O.Q. = Oil Quenched; T. = Tempered; N. = Normalised. Steels Nos. 3, 4, 5, 6, 7, and 9 manufactured by Bonney-Floyd Company.

black on the outside and the interior should be a dark green. As the refining cycle progresses, the outside of the slag has a tendency to become brown while the inside shows lighter tints of blue or green. Any tendency of the slag to become light brown on the outside indicates that silicon is being reduced in the bath at a very rapid rate, and this tendency should be stopped immediately or the heat should be tapped.

To stop silicon reduction, the balance of the slag must be disturbed, which can be done in some cases by an addition of sand and in extreme cases by sprinkling a little finely-powdered iron ore over the surface of the bath.

It is necessary after making up the finishing slag that the bath be allowed time to recover the temperature lost by the addition of the cold slag-making materials. When the bath is at about 1,590 to 1,645 deg. C., the metal should be recarburised by the addition of pig-iron. When the carbon is at the proper percentage, the final additions of manganese and silicon together with such alloys as chromium should be made. The use of silico-manganese is recommended and will produce a cleaner steel. In 15 min. the heat should be ready to tap. The use of aluminium as a deoxidiser is especially harmful, resulting in loss of ductility and increase in shrinkage. Properly-made steel requires little, if any, of this dangerous element.

Methods of Alloy Additions

Different alloys require different methods of addition to the bath. Nickel and molybdenum, which are not readily oxidised, should be charged in the furnace with the scrap. Chromium and manganese should be added about 10 to 15 min. before tapping time. Alloys which are as readily oxidised, as vanadium, must be added in the ladle.

It may be considered that undue emphasis has been placed upon the control of the slag, but any neglect on this score will result in metal which has a tendency toward porosity and lack of ductility. If the slag be not carefully regulated, it is impossible to produce a good alloy steel, no matter what alloy is involved.

Considerable latitude in pouring temperature is possible in the production of carbon-steel castings, but in the manufacture of alloy castings it is of the utmost importance that the metal be poured at a temperature just high enough to avoid mis-run castings. It is advisable to use an optical pyrometer to determine the temperature of the metal just before tapping the furnace, and the metal should be held in the ladle until it is cooled to the point where it will pour the work in question without leaving a skull in the ladle.

The majority of alloy steels have somewhat lower critical temperatures than carbon steel, and the heat-treating or normalising temperatures should be based upon the critical temperature of the steel in question. Castings should be heated thoroughly to a temperature about 25 deg. C. above the critical temperature and held at this temperature for not less than 2 hrs. per in. of section. They then should be quenched either in oil or water, or air-cooled. The castings must be reheated to a temperature below the critical temperature, but sufficiently high to remove cooling or quenching stresses. The temperature for this tempering treatment will be varied according to the physical properties required in the finished steel. The usual tempering temperatures range between 480 and 700 deg. C.

Castings of heavy section, which are to be heat-treated, are benefited by a preliminary normalising treatment at a temperature of 955 to 980 deg. C. For the usual run of castings, however, with sections not over 2 in., the necessity for this treatment is not urgent. It is impossible to place too much emphasis on the importance of good furnace equipment. Automatic recording and controlling pyrometer equipment is essential if maximum possibilities are to be realised.

Shrinkage Allowances

Patterns for alloy castings generally must allow for greater shrinkage per ft. than those for carbon steel. There is no standard rule for shrinkage allowance, but the majority of alloy castings will show a shrinkage of $\frac{3}{16}$ to $\frac{5}{16}$ in. per ft. Design, casting temperature and sand condition all have a most important influence on the shrinkage allowance which will produce accurate castings.

Because alloy steels have a greater shrinkage and because the steel is more "tender" and liable to crack at both elevated and ordinary temperatures, the moulding and coremaking departments must take greater precaution to produce moulds and cores which are collapsible after pouring. The tendency for more shrink-holes and cracks must be combated by a careful study of proper location of gates, and number, size and location of feeding heads. As compared with carbon steel, the percentage of castings produced related to the pouring weight is invariably lower.

Some alloy steels (especially those containing an appreciable amount of chromium) have a greater tendency to cut and penetrate a silica sand mould or core. For this reason, a more refractory and finer-grain sand usually is required, and careful attention must be given to the silica wash on the face of the mould. Recording control pyrometers on mould and core ovens are almost a necessity, to make certain that baking is done at the proper temperatures and for the required length of time. Sand reclaiming and conditioning equipment is of the greatest value, and the sand mixtures should be made under laboratory control. Permeability, strength and moisture content should be determined on all sand mixtures as a matter of routine.

Gates Removed from Hot Castings

Alloy castings will often cold-crack because of internal strain, if allowed to cool in the usual manner. This is especially true during cold weather. With castings of intricate design, it is usually necessary with any alloy steel to knock out the castings at a temperature of about 650 to 815 deg. C. and remove them at once to an annealing furnace of about the same temperature. The castings then are annealed thoroughly with the heads and risers attached and cooled slowly in the furnace. It is advisable for extremely intricate castings to reheat them to 600 to 650 deg. C. and transfer them from the furnace to the flame-cutters promptly for removal of the heads and gates with an oxy-acetylene burner before the castings become cool.

The carbon-steel castings, which may be knocked out and handled with impunity throughout the various burning, grinding, welding and chipping operations, may crack apart if made in an alloy steel and handled in the same manner. Local heating not followed promptly by annealing or heat-treating should be avoided especially.

A trained personnel is one of the prime requisites for the successful production of alloy-steel castings. Melting and heat-treating departments require technical supervision, and the entire staff requires no small amount of skill, patience and ingenuity to cope with the problems which present themselves daily. In addition to the usual testing equipment, a small melting unit capable of manufacturing 50 to 100 lbs. of steel will prove a good investment. In the foundry of the company with which the author is connected, a 50-lb. arc furnace is kept busy almost continuously producing pilot heats and experimental compositions. Many ideas which later proved to have great practical value have been tried out and demonstrated in this miniature foundry.

XUM

Experimental Researches Relating to Specifications of Welding Rods for Cast Iron with Particular Significance to Preheating

By L. J. Tibbenham

Many eminent authorities in various parts of the world have, in recent years, discoursed on the suitability of specially-prepared welding rods for the welding of ordinary cast iron, but it is the object of the author in this Paper to present a few interesting lines of thought hitherto unexplored in the art of welding.

The data about to be submitted are the outcome of research experiments, in consequence of having been connected with the manufacture of cast-iron welding rods for many years, and it is hoped that the deductions arrived at may prove of interest to oxy-acetylene welders, especially to those not having the opportunity of conducting individual experiments.

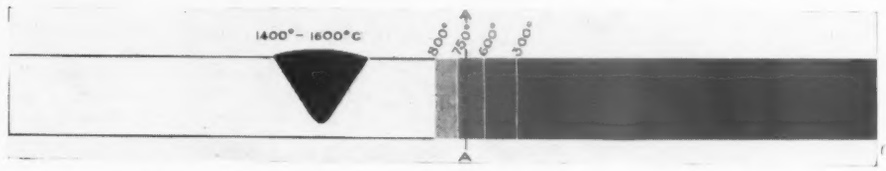


FIG. 1.—TEMPERATURE GRADIENT IN WELDED SLAB USING COLD STOCK.

Some years ago it was considered impossible satisfactorily to weld cast iron, owing to its peculiar structure, but more recent phenomena have been brought to disprove these theories. At the outset one must realise that the welding of such a complex iron-carbon alloy as cast iron is essentially a metallurgical operation, and in consequence must be treated as such.

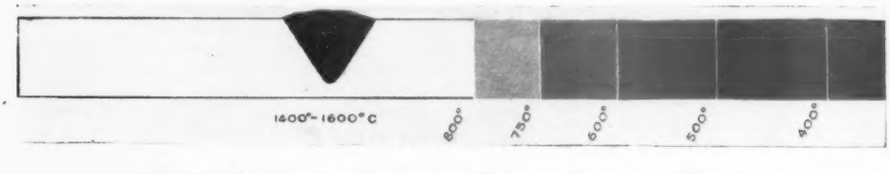


FIG. 2.—TEMPERATURE GRADIENT IN WELDED SLAB USING HOT STOCK.

Thus the fundamental problem which confronted metallurgists was to discover what structural or chemical changes were actually obtained after welding. Experiments were conducted with a filler rod having a very similar chemical analysis to that of the parent metal.

After welding, however, it was found that the analysis of the deposited rod metal had changed, the silicon and manganese contents having decreased, whilst the combined carbon had considerably increased, as is shown in Table I.

TABLE I.—*Change in Composition after Depositing Weld Metal*

	Gr.	C.C.	Si.	Mn.	S.	P.
Parent Metal ..	3.31	0.82	2.18	0.73	0.041	1.12
Welding Rod ..	3.33	0.96	2.19	0.73	0.039	1.13
Weld Metal	3.30	1.99	2.11	0.69	0.039	1.13

The resultant weld was naturally hard, due to the cementite structure ensuing, the Brinell hardness being 361.

In order to produce a softer weld, it was, of course, found necessary to increase or decrease certain elements contained in the rod, and a general standard analysis was evolved to suit the trade generally. Two brands, A and B, were marketed, the former, A, being cheaper, for use where machinability is not so important, whilst B was to be a slightly more expensive rod for producing soft machinable welds. The analyses of these two types of rods are as follow:—

Grade A:—T.C. 3.25 to 3.75; Gr. 2.55 to 3.05; C.C. 0.70 max.; Si, 2.5 to 3.0; Mn, 0.6 to 1.0; S, 0.10 max. and P, 1.0 to 1.3 per cent.

Grade B:—T.C. 3.25 to 3.75; Gr. 2.75 to 3.2; C.C. 0.56 max.; Si, 3.0 to 3.5; Mn, 0.5 to 0.80; S, 0.075 max. and P, 0.60 to 1.05 per cent.

Much has been said about the welding operation affecting the strength of the parent metal, and hence the importance of heat-treatment both before and after welding was regarded as being of paramount importance. That is to say, it is generally advantageous to preheat the entire article to be welded, but, as this is often not practicable, it has been found sufficient merely to preheat a reasonably large area in the zone of the weld. Such preheating is necessary to ensure that the heat from the blow-pipe flame is evenly dispersed throughout the parent metal.

Without preheating it was found that there was a zone outside the line of welding possessing a considerably altered structure, easier to fracture than the deposited weld metal, or the original parent metal itself.

To illustrate this phenomenon various experiments were made. Fig. 1 represents a slab of cast iron having been welded in the usual manner without preheating. It will be noticed that the temperature gradient is very steep, whereas in Fig. 2, where preheating has ensued, it is much more gradual, in consequence of which, as will be shown later, the strength is more evenly maintained through the entire mass.

A test-bar, 18 in. long by 1 in. sq. section, of grey cast iron, was made, having the following analysis:—T.C., 3.42; G.C., 2.30; C.C., 1.21; Si, 2.23; Mn, 0.69; S, 0.06; and P, 1.16 per cent.

From this drillings were taken at three points, and the analytical consistence of the entire structure confirmed. A microsection was prepared as shown in Fig. 3.

An examination of this section shows cementite and graphite slightly in excess.

The same bar from which this section has been cut, was then welded without preheating, with a rod of the following analysis:—T.C., 3.46; Gr, 2.81; C.C., 0.65; Si, 2.66; Mn, 0.82; S, 0.06; and P, 1.18 per cent.

The bar was cut through the weld, and a section, Fig. 4, was obtained, which shows that undoubtedly the structure of the metal is considerably changed after welding, as there is an excess of cementite.

A microsection was also taken at (A), Fig. 1, that is, where incandescence terminated, and the resultant photomicrograph (Fig. 5) illustrates the variation in structure due to the conduction of the heat from the flame during welding.

In this example it will be observed that graphitic carbon is in flakes, with a consequential weakening of the structure at a point in the parent metal about 1 in. from the weld proper.

It must be noted, however, that the actual chemical analysis of the iron has not been considered since the first test for uniformity, but at this juncture an analysis was taken of the structure shown in Fig. 4, which gave:—Gr. 2.17; C.C., 1.29; Si, 2.15; Mn, 0.71; S, 0.06; and P, 1.18 per cent.; whilst that of Fig. 5 was:—Gr. 2.53; C.C., 0.89; Si, 2.23; Mn, 0.69; S, 0.06; and P, 1.16 per cent.

It is obvious that, whilst the structure of both sections was materially affected, the chemical analyses were also changed.

The only alteration in the case of Fig. 5 is that due to the graphitic growth relevant to preheating. In the case of Fig. 4, however, the chemical changes are directly due to the oxy-acetylene process, that is, oxidation.

A graphical representation of this is given in Fig. 6, indicating that the graphitic carbon, whilst not being apparent in the weld metal, is

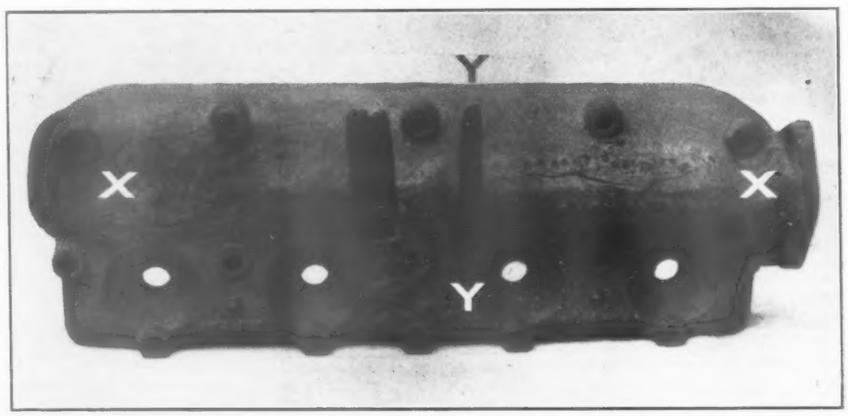


FIG. 7.—CASTING ON WHICH AN ATTEMPT WAS MADE TO WELD COLD. ORIGINAL CRACK WAS AT X—X, WHILST THE INDUCED CRACK IS AT Y—Y.

greatly in excess between the weld and the parent metal.

Therefore, it should be realised that the preheated bar possesses a more homogeneous structure and, although the tensile strength of the whole may not be quite so high as before welding, there is certainly no acute weakness as has been shown in the parent metal, which was not preheated.

Further to illustrate this point, two identical test-bars were cast and broken, and welded with rods of the same composition, that is, in a similar way to the previous experiments, with the object in view of obtaining definite strengths of the preheated and unpreheated bars.

The tensile strength of the preheated bar was 9.55 tons per sq. in., and that of the bar not so treated was 7.82 tons. Later a cylinder head was selected having a long transverse crack, as shown in XX in Fig. 7. This was initially welded with an ordinary cast-iron rod of grade A without preheating. As might be expected, the crack again appeared after welding, whilst an additional one developed at YY (Fig. 7), proving conclusively that important stresses had undoubtedly been set up. These are stresses due to contraction owing to the variation in thickness and design of the particular casting selected. However, a panoramic photomicrograph was taken along the line YY, from which it was observed that the overheated metal between the parent metal and that of the weld is of a weaker character than that of either of the two adjacent sections.

Analyses were taken at the three sections in question, which showed the following results:—*Parent metal*: Gr. 1.86; C.C., 1.05; Si, 1.1; Mn, 0.41; S, 0.052; and P, 0.70 per cent. *Overheated metal*: Gr. 2.31; C.C., 0.60; Si, 1.1; Mn, 0.41; S, 0.052; and P, 0.70 per cent. *Weld metal*: Gr. 2.27; C.C., 0.99; Si, 1.25; Mn, 0.52; S, 0.060; and P, 0.95 per cent.

The inference from these results was that the variation between the parent metal and that of the overheated zone was only the growth of the graphite. On the other hand, the difference between the structure of the overheated metal and that of the weld results from the application of a welding rod possessing a different chemical analysis from that of the parent metal. As has been shown, such a welding rod was used in order that the weld metal should have similar physical properties to that of the parent metal.

To overcome the difficulty of contraction, it was considered advisable to re-weld the casting introducing, of course, the operation of preheating. In this experiment, however, the rod used was of Type B, and the success obtained was apparent from a microscopical examination. Fundamentally, three microsections at and near the weld possessed similar structural characteristics, and there was not one point at which the graphitic carbon was in excess. Consequently, whilst the entire structure may be somewhat weaker, due to the presence of a slightly increased proportion of graphite throughout the whole, contingent, of course, upon preheating, there was no excessive weakness, as in the case of the experiment using no preheating treatment.

Chemical analyses at the three sections were taken as follow:—Between the parent metal and weld: Gr. 2.05; and C.C., 0.87 per cent. *Weld Metal*: Gr. 2.16; C.C., 0.95; Si, 2.65; Mn, 0.49; S, 0.059; and P, 0.68 per cent.

From these analyses it is inferred that the characteristics of the weld and parent metal are similar. The analysis of the weld metal is, of course, somewhat different in order to produce a structure with similar physical properties. In Fig. 6 the graphitic carbon is plotted against the distance away from the weld metal, and, of course, this indicates that the graphitic carbon, whilst not being apparent in the weld metal, is greatly in excess between the weld metal and the parent metal.

By the introduction of soda ash to the welding-rod metal for casting welding rods, it was found possible to effect a certain amount of refining, as to sulphur distribution. Moreover, the graphitic structure of the rod is also greatly improved, as is shown by Figs. 8 and 9,

FIG. 3.—STRUCTURE OF ORIGINAL METAL.

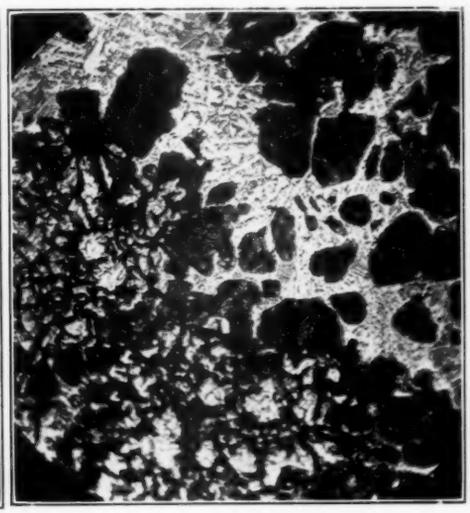


FIG. 4.—STRUCTURE OF WELD.

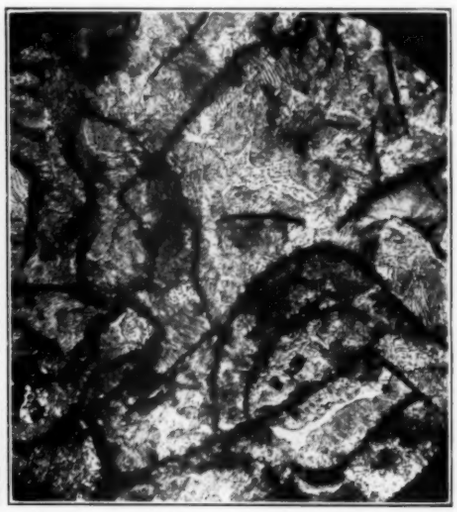


FIG. 5.—STRUCTURE OF METAL NEAR THE WELD.

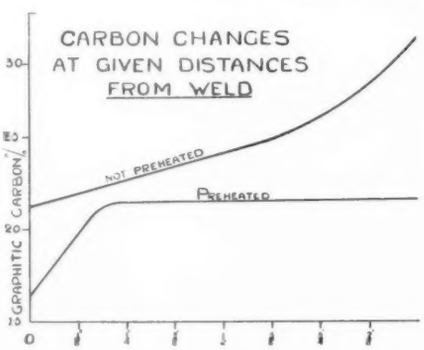


FIG. 6.—CARBON CHANGES AT INCREASING DISTANCES FROM THE WELD.

FIG. 8.—METAL FOR WELDING RODS BEFORE TREATMENT WITH SODA ASH.

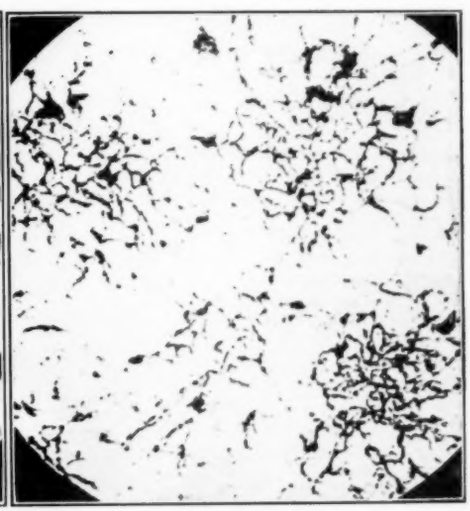


FIG. 9.—STRUCTURE OF METAL TAKEN FROM THE SAME LADLE AS FIG. 8 BUT TREATED WITH SODA ASH.

the former being cast from the same ladle of metal, but, of course, without the addition of soda ash.

The importance of the outer skin of a welding rod needs stressing, as bright hard spots on the surface of the weld puddle are often caused by impurities in the skin of the rod itself. As it is commercially impracticable to machine a welding rod, special consideration has been given

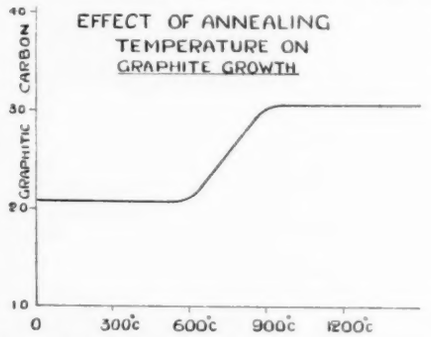


Fig. 10.—Effect of Annealing Temperature on Growth.

to the production of a rod having a skin free from sand inclusions and general surface defects.

After producing welding rods for many years from multiple moulds, the author has discovered that a much cleaner skin may result by the adoption of a flat mould. Such a method permits of inspection of the mould, and after rumbling or sandblasting a perfectly clean skin can be produced. Further refinement may be obtained with a suitable heat-treatment.

Fig. 10 indicates the growth of graphite against the annealing temperature. Therefore, in order to produce a very soft rod, it is necessary to heat to a temperature of 950 deg. C. and maintain at such a temperature for 90 min., afterwards cooling slowly. Controlled slow cooling re-distributes nearly all the combined carbon in a graphite state, thereby tending to produce a soft machinable weld. (*Extracted from a Paper presented to the recent International Acetylene Welding Conference at Rome. The author is managing director of the Suffolk Iron Foundry, Stowmarket.*)

Trade Prospects

(*Concluded from page* 99.)

The light-castings industry has perhaps most to gain by a thorough policy of national development at home, on roads, houses, public works and so on, but its effects would soon be felt throughout the trade.

Altogether, we feel that the country and the industry can face the autumn with confidence, and it is perhaps as well that the future does not offer such possibilities as to create a boom, which would inevitably be followed by a slump and resulting economic disturbances. We think that every business man and employee would prefer, say, five years steady and slowly expanding trade to the fluctuations consequent on violent movements of the trade cycle.

Following on the recent acquisition of Palmers shipbuilding yard at Jarrow by the National Shipbuilders' Security, Limited, the blast furnaces and steelworks at Jarrow, covering about 35 acres, fronting the River Tyne, have been bought by Messrs. Thos. W. Ward, Limited, of Sheffield.

A contract, valued at about £10,000, has been placed by the Great Indian Peninsula Railway with Sir W. G. Armstrong Whitworth & Company (Engineers), Limited, Newcastle-upon-Tyne, for the supply of 40 sets of steam cylinders of the Caprotti and Lentz type for "D"- and "H"-type locomotives.

Philadelphia International Foundry Conference

FORMAL INVITATION RECEIVED

The Institute of British Foundrymen has now received the formal official invitation to take part in the International Foundry Conference at Philadelphia in October next. The Conference will be opened on October 22, and will close on October 26, and will be preceded by a tour of important industrial centres. The letter of invitation reads as follows:—

"Mr. Tom Makemson,
Secretary, Institute of British Foundrymen,
St. John Street Chambers, Deansgate,
Manchester, 3, England.

"Dear Sir,

"The American Foundrymen's Association takes great pleasure in extending to you, and through you to the officers and members of the Institute of British Foundrymen, a hearty invitation to attend the Fifth International Foundry Congress and Exhibition in Philadelphia, October Twenty-second to Twenty-sixth, Nineteen Hundred and Thirty-four.

"This invitation reflects the sincere hope of the American Foundrymen's Association, its officers and Directors, as expressed at its convention in Chicago in Nineteen Thirty-three, that many of the foundrymen of your country may be present in Philadelphia this year.

"American foundrymen, who individually or as members of the overseas parties in Nineteen Twenty-three and Twenty-nine have visited your country, are appreciative of courtesies extended, and are hopeful of renewing once more the mutually pleasant contacts previously established.

"We hope that all of your officers and a large number of your members may be our guests at the convention this year, and that many of them may participate in the tour of American foundry centers scheduled to precede the opening of the Congress.

"Most sincerely yours,
Frank S. Lanahan, President.
Dan M. Avey, Vice-President.
C. E. Hoyt, Secretary."

Details of the arrangements are published in these columns from time to time (see page 107) whilst many Branches of the Institute have been visited by Mr. Vincent Delport.

Mr. Delport is organising a party of European foundrymen to visit this Conference, and the main party will sail from Plymouth on October 2. It is hoped that a very large number of British foundrymen and their ladies will accept the invitation of the American Foundrymen's Association, and all interested are invited to communicate with Mr. Delport and ask for further particulars. Mr. Delport's address is: Caxton House (East), Westminster, London, S.W.1.

Publication Received

British Standard Engineering Symbols and Abbreviations. Published by the British Standards Institution, 28, Victoria Street, London, S.W.1. Price 3s. 9d. post free.

So far as we are concerned, we have decided to follow the recommendations indicated in this booklet with just a few reservations. For instance, we object on chemical grounds to the use of NiS for nickel steel; whilst S.C.I. does not appeal to us as being a suitable abbreviation for "soft cast iron." We would like all those people who intend writing Papers or books to furnish themselves with a copy of this pamphlet, as some of the abbreviations and symbols used by authors are, to say the least of it, definitely unconventional.

The Iron and Steel Institute

AUTUMN MEETING IN BELGIUM AND LUXEMBURG

As previously announced, the autumn meeting of the Iron and Steel Institute will be held in Belgium and Luxemburg, by the kind invitation of Messieurs Léon Greiner and Aloyse Meyer, with the support and co-operation of the industrialists of those countries. The arrangements for the meeting have been carried out by influential reception committees, the hon. secretaries of which are Monsieur Auguste Greiner (Belgium) and Monsieur A. Kipgen (Luxemburg).

The sessions will take place at the Palais des Académies, Brussels, on Monday and Tuesday, September 10 and 11, at the Hotel de l'Arbed, Luxemburg, on Thursday, September 13. The subsequent arrangements include visits and excursions to the principal iron and steel manufacturing and engineering establishments in Belgium and Luxemburg.

The following is the complete list of Papers to be presented at the meeting:—

1.—"The Influence of Vanadium on Carbon Steel and on Steels containing Nickel and Chromium," by H. H. Abram.

2.—"Belgian Research Committee on the Behaviour of Metals at Elevated Temperatures," by H. Dustin.

3.—"Some Aspects of the Fatigue Properties of Patented Steel Wire," by E. T. Gill and R. Goodacre.

4.—"The Blistering of Iron Oxide Scales and the Conditions for the Formation of a Non-Adherent Scale," by R. Griffiths.

5.—"The Decomposition of Martensite," by Gunnar Hägg.

6.—"Accelerated Cracking of Mild Steel (Boiler Plate) under Repeated Bending. Part II.—Further Tests," by C. H. M. Jenkins and W. J. West.

7.—"The Influence of Diffusing Elements upon the Alpha-Gamma Inversion of Iron," by W. D. Jones.

8.—"The Constitution of Iron-Rich Fe-Al-C Alloys," by F. R. Morral.

9.—"Contribution to the Study of the Resistance to Chemical Attack of Various Special Steels," by A. Portevin, E. Prétet and H. Jolivet.

10.—"The Properties of Non-Hardenable Alpha-Iron Steels," by S. H. Rees.

11.—"Flexibility as a Factor in the Economic Exploitation of Rolling Mills and some Technical Means for its Realisation," by G. A. V. Russell.

12.—"The Physical Properties of Iron-Aluminium Alloys," by C. Sykes and J. W. Bampfylde.

13.—"The Influence of Silicon and Aluminium on the Resistance of Cast Iron to High Temperatures," by H. Thyssen.

Catalogue Received

Quenching Oils. Reliable information on the subject of quenching oils for metallurgical use is in the ordinary way rather elusive, and it was with a considerable amount of interest that we perused a pamphlet received from G.W.B. Electric Furnaces, Limited, of Elecfurn Works, North Road, London, N.7. Herein, are detailed several experiments carried out with a view to ascertaining the relative cooling capacities of a number of liquids, as well as notes upon surface tension, stability, viscosity and effect of cyanide on quenching oils. In the production of these oils, which are known as Shell-Wild-Barfield, there has been close collaboration with Shell-Mex and B.P. Limited.

Fifth International Foundrymen's Congress

Developments and progress in the castings industry throughout the whole world will be the theme of the Fifth International Congress to be held in conjunction with the 38th Annual Convention and Exhibition of the American Foundrymen's Association in Philadelphia, October 22 to 26. Modern developments will be presented from three angles: advances in technical knowledge, progress in operating practice, and latest design and improvements in foundry equipment. The fact that all convention activities will be held under one roof makes possible close co-ordination between the different interests, and meetings have been so scheduled that plenty of time is allowed for inspecting the Exhibition. The programme of Papers, discussion, informal meetings, and exhibition of equipment will provide valuable information on many phases of foundry work.

A feature of this Congress is the unusual number of Papers from foreign foundry groups. Australia, Belgium, Czecho-Slovakia, England, France, Germany, and Italy are contributing Papers dealing with modern foundry practice in those countries.

Materials Handling

One of the sessions which will be of interest to all foundrymen is the materials-handling session. Executives will find special attention given to the problems of foundry maintenance, and the selection of foundry equipment as an investment.

Refractories will be the subject of a second general interest session. Several Papers of unusual practical value will be presented, among them, a discussion of the relation between slags and refractory linings, a *résumé* of modern crucible melting equipment, and a study of the properties of clays obtained from different sources.

The shop-operation course on sand control, which has been one of the most popular and instructive features of former conventions, will be repeated this year. There will also be a session on sand control and research, where questions of analysis, supplies, and methods of control will be studied.

Sessions on Cast Iron

Grey-iron founders will find an especially full programme arranged for them. Two sessions, a round-table luncheon, a shop-operation course on cupola practice, and a joint A.F.A.-A.S.T.M. meeting on cast-iron tests and specifications, have been planned. Among the outstanding Papers are those contributed by foreign foundry associations. Germany and France send Papers on high-test grey iron as made in those countries. The Italian Exchange Paper deals with the chemical composition of common cast iron for boilers. It is expected that the Belgian Exchange Paper will give data on grey iron which have been collected under the auspices of the Belgian Research Foundation, and which should be of great value. At the joint A.F.A.-A.S.T.M. meeting on tests and specifications, Papers on high-chromium cast iron, and data on fatigue tests of high-strength iron, will be given.

Sessions on Steel

A general session on steel, another on the porosity of steel castings, and a round-table luncheon are planned for steelfounders. One of the most interesting Papers in view is that offered by the Institute of British Foundrymen, on "Steel Castings," by Dr. W. H. Hatfield. Problems of solidification and contraction, and a study of controlled directional solidification, will be discussed at the general steel castings session.

Sessions on Malleable Cast Iron

The effect of copper in malleable iron, especially its influence on the annealing time, will be reported to those interested in malleable iron. The report of the committee on nomenclature, giving recommendations for names of different products made in malleable foundries, will be another feature of this session. The round-table luncheon will deal with practical problems.

Sessions on Non-Ferrous Castings

A symposium on deoxidation and degasification of non-ferrous castings alloys, a general session and a round-table luncheon are scheduled for non-ferrous founders. At the symposium there will be a discussion of general principles; then the meeting will take up bronze-foundry alloys, yellow-brass casting alloys, and aluminium and its alloys. The general session on non-ferrous castings will be rich in practical information. Porosity in leaded bronze bushings, and cupola melting of red brass, are two of the subjects to be considered.

Tentative Programme

Monday, October 22.

Morning: Registration and Committee Meetings.
Afternoon: Formal Opening of Exhibition. Shop-Operation Courses.
Evening: Annual Alumni Dinner.

Tuesday, October 23.

Morning: Formal Opening Meeting.
Afternoon: General Session on Steel Castings. General Session on Non-ferrous Castings. Session on Apprentice Training. Shop-Operation Courses.
Evening: Reception to Overseas Guests.

Wednesday, October 24.

Morning: Symposium on Porosity on Steel Castings. Session on Refractories. Session on Cast Iron.
Noon: Round-Table Luncheon for Non-ferrous founders. Round-Table Luncheon for Steel founders.
Afternoon: Session on Refractories. Shop-Operation Courses.

Thursday, October 25.

Morning: Session on Cast Iron. Session on Malleable Cast Iron. Session on Materials Handling and Foundry Equipment.
Noon: Round-Table Luncheon for Grey-Iron Founders. Round-Table Luncheon for Malleable-Iron Founders.
Afternoon: Special Lecture and Medal Awards. Annual Business Meeting. Shop-Operation Courses.
Evening: Annual Banquet.

Friday, October 26.

Morning: Joint A.F.A. and A.S.T.M.—Session on Cast Iron. Session on Sand Control and Research.
Afternoon: Special Plant Visit.

Exhibits open daily 9 a.m. to 5.30 p.m. except Wednesday, when the closing hour will be 10 p.m.

Iron and Steel Production

The British Iron and Steel Federation, in its "Statistical Bulletin" for June, states that the output of pig-iron and steel in the United Kingdom in June was at approximately the same rate as in the previous few months. The number of furnaces in blast at the end of June was 100, a net decrease of one since the beginning of the month, but the pig-iron production, at 514,900 tons, was 1 per cent. in excess of the rate in the previous month. The production of steel amounted to 757,500 tons, compared with 780,000 in May. The slight decline is attributable to the shorter working month. The output of pig-iron in the first half-year amounted to 2,898,400 tons, compared with 1,899,800 tons for the first half of 1933, while steel production amounted to 4,507,300 tons, compared with 3,182,800 tons in the first half of 1933.

Modern Pulverising

A NOTABLE AIR-SWEPT TUBE MILL

Considerable interest attaches for pulverised-coal firing on the unit system to the latest designs of the "Kennedy" tube mill. Although opinions differ on the subject, the unit system is now generally regarded, especially for metallurgical work, as possessing a number of advantages in comparison with the bin and feeder system, such as simplicity, convenience, small floor space, and low cost. One of the main requirements also of economical, reliable and efficient pulverising is slow speed.

Essentially the "Kennedy" mill, manufactured by the Sheepbridge Coal & Iron Company, Limited, Chesterfield, is a short, horizontal, air-swept tube mill, with forged-steel balls, running under the slow speed conditions of 17½ to 50 r.p.m., according to the size, without noise, and the emission of smoke and dust.

The result is to reduce bituminous coal direct in one operation to a degree of fineness equivalent to 85 to 95 per cent. through a 200-mesh screen, and 60 to 75 per cent. through a 300-mesh screen, while the total maintenance costs do not exceed about 1½d. per ton of bituminous coal. Also coal up to 15 per cent. moisture can be pulverised without pre-drying, as well as other solid fuels, such as anthracite, coke, coke breeze, petroleum coke, and tar residues.

It is hardly necessary to emphasise that such fine pulverising is of the utmost importance for

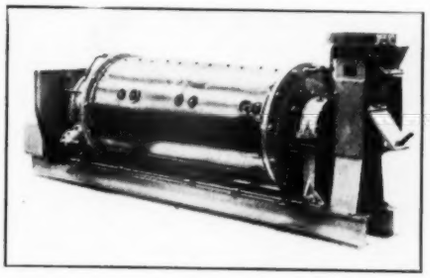


Fig. 1.—The "Kennedy" Air-swept Tube Mill for Pulverised Coal with Worm Drive running in Oil. Sheepbridge Coal & Iron Company, Limited.

rapid and efficient combustion, and the results are superior to the ordinary figure of 90 per cent. through a 100-mesh screen, and 70 to 80 per cent. through a 200 mesh. Coal also can be taken direct when in pieces not over about ¾-in. size, being supplied continuously from the hopper to the mill by a special design of motor-driven disc feeder. The air current passing through the mill to the burners, giving automatic grading of the coal particles by gravity flotation, is provided by a variable-speed self-contained fan, while no screens of any kind are used and no magnetic separators. Almost the only wear and tear is on the steel balls, and mills of this type have pulverised up to 20,000 tons of coal without any renewals except the balls. Noise and dust are eliminated by the simple principle of preventing them from escaping.

With regard to the mill drive, various methods are available according to the conditions, including, for example, direct gear drive from an electric motor with a double-helical pinion on the motor shaft engaging with a large gear wheel on the mill cylinder at the opposite end to the coal feed. Notable also for still more silent running is a worm-gear drive operating in a closed oil bath, with the worm on the motor shaft engaging with a worm wheel on the hollow trunnion of the mill. Included is forced lubrication for the main bearings, with continuous circuit of the oil to and from a reservoir through a cooling coil.

XUM

Company Meeting

Buell Combustion

Strenuous Development of Pulverised Fuel Section

The seventh ordinary general meeting of the Buell Combustion Company, Limited, was held on Tuesday, at the Hall of the Institute of Chartered Accountants, Moorgate Place, E.C.

Mr. J. A. Agnew (the chairman), after dealing fully with the accounts, said that during the year under review, however, the issued capital has been increased to £245,140, by the issue of 2,000 shares as fully paid. These shares were issued in respect of certain services rendered to the company in connection with the change in the organisation which was effected in December, 1932.

Assets of Foreign Company Acquired

Since the date of the accounts we have issued a further 4,292 shares to shareholders of Buell Combustion (Foreign), Limited, as part consideration for the acquisition of the assets of that company.

The item shown as being due to Buell Combustion (Foreign), Limited—£225 16s. 9d.—will, of course, now be absorbed in the incorporation of that company's assets in our accounts for the present year.

On the credit side of the balance-sheet the securities at cost stand in the books at £42,908 11s. 10d. The market value, however, as at December 31 last, the date of the accounts, was £45,840.

The value of Buell Combustion (Foreign), Limited, shares as shown in the accounts at £68,015 13s. 2d. is the same as at the date of the previous accounts.

Buttner Licence Agreement

The item of £992 9s. 2d.—initial payment and costs in respect of the Buttner licence agreement—represents payments made to the date of the accounts with regard to this licence. The terms upon which this licence has been acquired stipulate that a certain minimum royalty must be paid each year. We consider this minimum has been fixed on a fair basis and we anticipate that our sales, even during the first years during which the licence will operate, will be more than sufficient to cover the royalty to be paid.

The development and experimental account now stands at £19,091 17s. 8d., having been increased during the year by £3,575 0s. 10d. The latter figure represents expenditure incurred on development of our various assets, except for an amount of £2,000, this relating to the 2,000 shares issued, to which I have already referred.

Turning to the profit-and-loss account, the balance of royalties received, after deducting those paid, amounts to £906 9s 8d., which shows an increase over the previous year, while trading showed a small balance of £1,185 15s. 3d.

Establishment charges, which include all salaries, advertising, rent, travelling and general expenses, amount to £8,683 9s. 11d. The increase in this item during the year is occasioned by our having set up our organisation on a proper footing to adequately cope with the company's business. To make our various products known, we have naturally had to undertake an advertising campaign. Additional staff, expert in their own branch, have been engaged to deal with the plant which we are now manufacturing under licence.

Pulverised Fuel Development

During the period under review, the pulverised-fuel section of our business has been strenuously developed in many industrial spheres of application, both in this country and the Dominions, and although we have had to contend with inertia, due to general trade conditions, and the apathy of industrialists towards the use of pulverised fuel, I am pleased to state that improvement in trade and greater confidence in the use of pulverised fuel, following the successful commissioning of installations for which we have been responsible, have created a most encouraging outlook for our system.

The Buell system of pulverised-coal firing has been applied during the past year to a number of important industrial operations, and among these I would mention metal melting, malleable-iron annealing, cast-steel straightening, lead liquating, drop forge and cast-steel annealing furnaces. The results attending the conversion of these furnaces prove conclusively the economic advantages to be derived from the utilisation of pulverised-coal firing.

In the steam-raising field, success has attended our installations on water-tube and flame-tube type boilers and repeat orders recently obtained indicate the satisfactory nature of our equipment. However, the volume of business in this particular sphere of application has been somewhat restricted, and it must be explained that industrialists hesitate to adopt this mode of firing on account of the publicity given to the danger of dust emission to atmosphere.

Danger of Dust Emission Overcome

These fears are in many cases unfounded, and with a view to mitigating any such danger, we have recently acquired, in conjunction with Messrs. Edgar Allen & Company, Limited, the British Empire rights of the Van Tongeren system of flue-dust precipitation, which is a highly-developed means of dealing with this problem. The Van Tongeren system is in successful industrial commission on over 150 installations on the Continent, and although these rights have only been acquired recently, we have been successful in introducing the system to several important industrial concerns in this country.

The acquisition of these rights is an important development of our activities, and the business accruing has made it desirable to create a separate department for the handling of this equipment. The Van Tongeren system includes three specific types of separators for effecting precipitation of solids carried in gaseous streams, and while reference has been principally directed to its use as a means of preventing dust emission to atmosphere from pulverised-coal-fired installations, there is, nevertheless, wide scope for it in many industrial applications where dust-collection plant is required, and in this connection I would mention that the Van Tongeren system forms an integral part of many of our dryer installations.

Pulvex Mill

The Pulvex mill has been successfully developed and manufactured in four different sizes for incorporation in our contracts, and the performance of the mills has proved that they possess distinct advantages over already existing types. However, with the extended use of pulverised-fuel firing and the utilisation of powdered coal for oil-extraction purposes, the necessity for extreme and consistently-maintained product fineness, at commercial cost, becomes more pronounced, and in anticipation of these requirements we have been particularly fortunate in acquiring the world's rights of a system of reducing coal and other materials to a fineness which has hitherto not been considered possible of attainment on a commercial basis.

The extreme fineness to which varying grades of coal have been reduced by this system, operating on a commercial scale, at a cost not greater than that incurred by ordinary types of pulverising mills producing standard product fineness, not only opens up vistas of applications hitherto closed for reasons closely associated with the question of economical limits of fine grinding, but makes practicable the attainment of combustion conditions previously considered possible only in theory. The system referred to is now known as the Microniser.

We have in a comparatively short time made preparation for the adaptation of this system of pulverising to various special industrial applications, and of these I would particularly mention central power-station practice, locomotive firing and the grinding of metalliferous ores.

Application to Shipping

Whilst the paralysed state of shipping has quite naturally had a deterrent effect on the extended use of pulverised-coal firing for marine propulsion, recent discussions with our marine licensees lead us to believe that the pulverising system to which I refer should introduce factors of such importance into the economics of this phase of firing as to warrant serious attention being given to its extended use.

The use of our system of pulverised-coal firing has been extended to small sectional heating boilers and other forms of steam raising and metallurgical heating, where the size of the units does not permit of the installation of pulverising plant. I am pleased to say that we have since entered into an arrangement with Messrs. Rickett Cockerell & Company, Limited, for the establishment of a central pulverising station at Deptford, for the supply and distribution of powdered fuel to users in the London area. It is expected that this station will be in operation within the next two months and substantial contracts have already been received for the supply of this fuel.

Progress with Buttner Dryers

At the last meeting, we were on the point of concluding, in association with Messrs. Edgar Allen & Company, Limited, an arrangement whereby we were to obtain the sole licence for the manufacture and sale of Buttner dryers for the British Empire. I am pleased to say that this arrangement has been concluded and our rights have been extended to include further types of Buttner dryers, so that we are now in a position to handle practically every kind of industrial drying application. As you will appreciate, much time and energy has been needed to build up an efficient organisation to deal effectively with this important acquisition; a number of important contracts have already been obtained, many others are on the point of maturing, and the business in prospect fully justifies our action in acquiring these rights. An important asset in connection with these rights is the co-operation of our German associates and their research department, which is actively engaged in the consideration of special applications for the furtherance of the use of this drying system.

The Davidson grate has been developed during the period under review and from results obtained on a demonstration unit applied to a billet reheating furnace, a fair proportion of business is anticipated for this unit.

Edgar Allen & Company have placed contracts with us for plant on various equipment within their works for demonstrating the importance and utility of our specialities to potential users, and facilities have also been given us for the equipment of a test station at the Imperial Steel Works. Further, our connection with them has been strengthened by the mutual acquisition of specialities ancillary to our equipment.

The American Organisation

As the result of long and considerable investigation of the American market by members of our staff, an American organisation has been set up on similar lines to the parent company. The other parties financially interested in the Buell organisation of America are the Gold Fields American Development Company, Limited, and the Struthers-Wells Titusville Corporation. The Struthers-Wells Titusville Corporation have undertaken, in addition to their financial interest in the new organisation, to afford us, free of charge, certain administrative and technical services, and they will be in a position similar to that occupied on this side by Messrs. Edgar Allen & Company, in so far as they will have the exclusive manufacturing rights of our specialities in the United States. A careful survey was made in the United States by our representative of the many companies using heavy chemical and general engineering equipment, and I am pleased to say that the Struthers-Wells Corporation takes the second place in this field from the standpoint of importance.

The rights of the Buttner drying system for America have been acquired by us and also the rights of the Van Tongeren system for the entire American Continent, and since we have the world's rights of the Microniser, licences for these three systems have been granted to the Buell organisation in the United States.

Development overseas continues, and has been enlarged upon by the appointment of engineering representatives in New Zealand and Australia, and in view of business possibilities in the Union of South Africa, it is our intention in the near future to appoint a full-time engineering representative in South Africa.

The Future

With the gradual, though slow, improvement that is taking place in industrial matters generally, we look forward with complete confidence to a successful outcome to our efforts to put this business on its feet. The creation of a high specialised staff, under the capable direction of the company's technical adviser, Dr. Blythe, is calculated to have an important influence on our future business, and we are gratified by the steadily-growing recognition of the advantages that the company's products have to offer to the industrial community generally.

I have again to express on behalf of the board our appreciation of the excellent service that is being rendered to the company by Dr. Blythe. By way of expressing in tangible form our recognition of the work performed by Dr. Blythe, we have appointed him a director of the company.

The meeting ended with a cordial vote of thanks to the chairman and directors.

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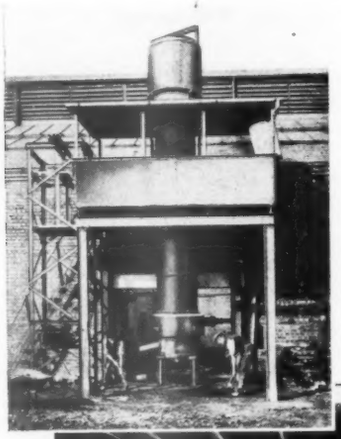

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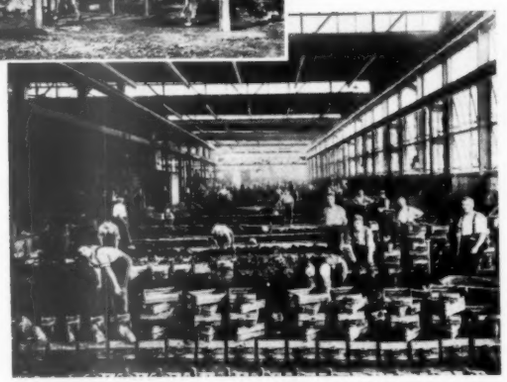

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This Week's News in Brief

Trade Talk

PLANS FOR CONVERTING the former Lunghua Arsenal in Shanghai into an iron and steel works are being made by the Chinese Ministry of War.

MESSRS. LITHGOWS, LIMITED, Port Glasgow, have sold a cargo steamer of 8,500 tons to a British firm, and it is expected that the vessel will be launched in about a fortnight. The machinery will be supplied by Messrs. Rankine & Blackmore, Limited, Greenock.

LARGE CARGOES continue to be a feature at Glasgow Harbour, including 5,000 tons of iron ore from Bilbao and several from other districts. The steamer "Lady Brenda," which has been purchased by the Soviet Government, has arrived at Princes Dock and is loading a cargo of steelwork for Leningrad.

A COLLIER OF 1,600 TONS, specially designed to take coal from the Wallarah Colliery, Catherine Hill Bay, Australia, to bunker ships at Sydney, was launched by Messrs. Henry Robb, Limited, Leith. The vessel, the "Munmorah," is 230 ft. in length, fitted with triple-expansion engines and has a speed of 10½ knots.

THE CROWN AGENTS for the Colonies have placed an order with Messrs. P. & W. Maclellan, Limited, Glasgow, for structural steelwork for a 325-ft. suspension bridge over the River Prah, Gold Coast, and also an order with Messrs. Alexander Findlay & Company, Limited, Motherwell, for a 200-ft. span for a bridge for Jamaica.

MESSRS. A. C. WICKMAN, LIMITED, Coventry, have been appointed the sole agents in the British Isles for Abawerk G.m.b.H. Alig & Baumgartel, of Aschaffenburg, Germany, for the sale of their "Wimet" fine grinding and lapping machine, combined jig boring and grinding machine, and precision surface grinding machine.

AMONG RECENT ORDERS, Messrs. Kryn & Lahy (1928), Limited, Letchworth, Herts, have obtained a large contract for a total weight of 120 tons of miscellaneous castings from a well-known rolling-mill corporation. Some of the items will be of mild steel, some of high-carbon steel and the remainder of the well-known K.L. "Stronger Steel."

A CONTRACT HAS BEEN SIGNED for a new motor coastal ship which will be built by the Ardrossan Dockyard Company, Limited, for Coast Lines, Limited. The vessel will be 250 ft. in length and 38-ft. beam. The propelling machinery will consist of two British Polar-Atlas marine engines to be installed by Messrs. John G. Kincaid & Company, Limited, Greenock.

OWING TO THE INSTALLATION of new machinery in several of the departments and the introduction of equipment for handling the heavier types of locomotives which has created a revival of work, the L.N.E. Railway Company at Cowlairs Works, Glasgow, have reinstated a number of workmen who, prior to the summer holidays, received notices terminating their employment.

A NEW PRODUCT has been placed on the market by Birchall & Company (Oils), Limited, Métiér Works, College Street, Rochdale, which, when painted on moulds and cores, prevents the metal from fusing the sand surface. The face of the metal is left quite clean after casting, as all the sand leaves the steel immediately when the casting is taken from the mould. It is marketed under the trade name of "Coro. C.M.P."

A NEW INDUSTRY is to be set up in the Glasgow district for the manufacture of electrodes for electric welding. Mr. J. G. Fraser, of the Development Board for Glasgow and District, in making the announcement, stated that a Scottish company was being formed to launch the project, and at present the promoters were looking for suitable premises. The electrodes to be manufactured are of the covered variety.

THE ANNUAL OUTING of the staff and employees of Messrs. Taylor's Muirhall Foundry, Larbert, was held on Saturday, August 4. The company proceeded to Glasgow by motor-coaches, where they took train for Wemyss Bay to join the steamer to Whiting Bay. On the return journey a call was made at Rothesay for tea. In spite of broken weather, the outing proved in every respect very successful and enjoyable affair.

THE CALEDON SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Dundee, launched the "Kirkland," a steamer built for Messrs. James Currie & Company, Limited, Leith. The vessel is 260 ft. in length, with a gross tonnage of 1,250. She is of the shelter-deck type, with a raked stem and cruiser stern. The propelling machinery, provided by Messrs. Barclay Curle & Company, Limited, Glasgow, consists of a single set of triple-expansion surface condensing marine engines.

MESSRS. PEGLERS, LIMITED, Belmont Brassworks, Doncaster, distributed last week, to more than a thousand employees, an annual bonus in the form of a double week's wages. The gift was particularly welcome in the height of the holiday season, but holidays at the Pegler brassworks are taken individually, not *en masse* by a general closing down, as is the case with many industrial places in Yorkshire about this period. The works close only on the statutory holiday days of the year.

THE PALESTINE METAL WORKS at Jaffa have taken up manufacturing of automobile parts and accessories as their principal activity. The only metal-stamping and expanding machinery in Palestine is operating here, and auto-lamps are produced at half the cost of imported articles. The factory has an export trade to Egypt and Syria. The factory has its own galvanising and nickel-plating departments and manufactures automobile radiators as well as screws and other parts for construction of automobile chassis.

H.M. CRUISER "GALATEA" was launched last week at the yard of Messrs. Scotts' Shipbuilding & Engineering Company, Limited, Greenock. The vessel has a tonnage of 5,200, and represents the smallest class of cruiser recently built for His Majesty's Government. She is 480 ft. in length, with 51-ft. beam, and carries a full equipment of 6-in. and 4-in. guns, 21-in. torpedo tubes and seaplane catapult. The propelling machinery consists of four sets of single-reduction geared turbines of the Parsons reaction type.

THE QUESTION of the displacement of labour as a result of mechanisation is discussed in an article in the current "Monthly Review" of Barclays Bank. The writer says that "in a well-balanced economic organisation there is no limit to the possibility of expanding consumption as production increases, and consequently, if hours of work are restricted, it is in effect a voluntary acceptance on the part of the community of a lower level of output and consumption than the progress of science and invention has made possible. Although it is undoubtedly true that improvements in mechanisation such as have recently occurred do cause dislocation and hardship among certain sections of the population, yet over a period the country and the world, as a whole, reap a considerable benefit in one way or another. If it were decided to shorten the working week with the sole object of offsetting the increased productivity of labour due to greater technical efficiency, the tendency would be to stabilise existing conditions to the detriment of future progress, while if, as is often advocated, such action were to be taken independently in a single country without lowering other costs, including wages, the competitive power of industry might be seriously weakened, leading to further unemployment, coupled with a decline in the national income available for distribution."

Company Meeting

Bengal Iron Company, Limited

The annual meeting of the Bengal Iron Company, Limited, was held on Thursday, August 2, in London, MR. WM. TURNER MACLELLAN, C.B.E. (chairman and managing director), presiding. Apologising for having to present again a disappointing report, he said that although there had been some revival in the iron trade it had not been of such an extent as to enable them to restart their blast furnaces. The foundries during the year had been busy and still continued so, and the profit for the year was slightly in excess of that of last year. Trade generally in India was distinctly improving, but it was too early to prophesy anything in regard to the current year. They had decided to liquidate the Firebrick Syndicate, as owing to the furnaces being at a standstill their requirements in firebricks were much reduced, and Semra, which they had also written off, was a limestone property for which at the present time they had no use. Some £18,000 had been spent during the year in keeping in good order the furnace plant and ore mines, but should trade improve they could restart at short notice.

Personal

MR. JOHN CRAIG, C.B.E., chairman and managing director of Colvilles, Limited, has been appointed Deputy-Lieutenant of the County of Lanark, dating from August 3.

MR. CHARLES BRUCE GARDNER has joined the boards of Armstrong Whitworth Securities Company, Limited, and Sir W. G. Armstrong Whitworth & Company (Engineers), Limited.

MR. DAVID TRAILL, foreman iron dresser with Messrs. Henry Balfour & Company, Co. Leven, Fife, has retired after 50 years' service. He received presentations from his employers and fellow-workers.

MR. JAMES HORNBY JOLLY has been appointed a managing director of Guest Keen & Nettlefolds, Limited. Mr. Jolly, who was secretary to the company, was recently elected to the board. Mr. E. C. Drake, who is chief accountant of Guest Keen & Nettlefolds, Limited, has been appointed secretary in succession to Mr. Jolly.

Wills

BURNS, JOHN HENRY, director of the Millom & Askam Hematite Iron Company and the North Lonsdale Iron & Steel Company £82,759

Contracts Open

Plymouth, August 25.—Founders' and smiths' materials, for the Plymouth City Council. Mr. R. J. Fittal, Town Clerk, Municipal Buildings, Plymouth.

Australia, October 11.—Turbo-alternator, for the Townsville City Council. The Department of Overseas Trade. (Reference A.Y. 12,535.)

Johannesburg, September 17.—Pumping equipment for Port Elizabeth Harbour, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference G.Y. 14,113.)

Old Fletton, August 27.—Supplying and laying about 9 miles 8-in., 7-in., 6-in. 5-in. and 4-in. spun-iron water mains, with valves, etc., for the Old Fletton Urban and Norman Cross Rural District Council. Messrs. G. B. Kershaw & Kauffman, 9, Victoria Street, London, S.W.1. (Fee £5, returnable.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Pyroheat, Limited, 1257, Pershore Road, Stirchley, Birmingham.—Capital £2,000 in £1 shares. Annealers, consulting metallurgists, mechanical engineers, etc. Director: W. H. Carter.

Brandeis, Goldschmidt & Company, Limited.—Capital £600,000 in £1 shares. To take over the business of metal brokers, merchant bankers and merchants carried on as "Brandeis, Goldschmidt & Company." Directors: E. Goldschmidt, P. H. Kohn-Speyer, L. K. Brindley, F. O. P. Becker, E. P. Kohn-Speyer and Mrs. E. C. Goldschmidt. Subscriber: C. Surtees, 18, Austin Friars, E.C.2.

Company Report

Swan, Hunter & Wigham Richardson, Limited.—Interim dividend on the 6 per cent. preference shares for the year 1934.

Obituary

MR. JOHN DARGAVEL, who was for over 50 years in the employ of Messrs Colvilles, Limited, at the Dalzell Works as a roll turner, has died. He had been in poor health for some time.

MR. WILLIAM MCGREGOR, patternmaker, 7, Kirkhill Crescent, Prestwick, Ayrshire, who was for over 40 years in the service of Messrs. John Brown & Company, Limited, Clydebank, died last week at Ayr County Hospital.

MR. NORMAN WILLIAM GODFREY, of Norton Grange, Knowle, near Birmingham, for some time chairman of Thomas Smiths' Stampings, Limited, Coventry, and also Smith-Clayton Forge, Limited, of Lincoln, died last week.

XUM

FOUNDRY BOXES

...that speed up production for the Modern Foundry—

One of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX . . . . the result is speed and economy all round. Your moulders will put down more moulds per day because of the light and easy handling properties of these boxes.

You will be sure of producing accurate castings because STERLING BOXES maintain their accuracy permanently. Also your moulding costs will be halved—STERLING BOXES stand up to heavy service, anywhere.

Sterling

UP-TO-DATE
MOULDING BOX EQUIPMENT

Save their cost in a few months, and are obviously a sound investment for any foundry.

STERLING FOUNDRY SPECIALTIES LTD.,
WORKS— **BEDFORD.**
LONDON OFFICE:— 13, VICTORIA STREET, S.W.1.
AGENTS: GLASGOW - MANCHESTER - NEWCASTLE.

Raw Material Markets

Rather more activity has been seen in the iron and steel markets during the past week, although holiday influences have not yet been shaken off. The undertone remains very confident, however, and a strong resumption of buying is anticipated towards the end of the month. A fair demand for pig-iron has enabled the furnaces to maintain production without making excessive additions to their stocks.

Pig-Iron

MIDDLESBROUGH.—The falling-away in the local demand for pig-iron has forced the producers to make additions to their stocks, but these should be rapidly absorbed when the expected autumn demand materialises. The export trade is very limited, tariff barriers, frozen credits and keen competition from overseas combining to prevent any great expansion in that direction. Prices are unchanged. No. 3 Cleveland G.M.B. being 67s. 6d. delivered Middlesbrough, 69s. 6d. delivered North-East Coast, 67s. 3d. delivered Falkirk, 70s. 3d. delivered Glasgow. No. 1 foundry is 2s. 6d. per ton more than the foregoing prices, and No. 4 foundry and No. 4 forge iron 1s. per ton less.

The demand for East Coast hematite keeps up very well, largely owing to its cheapness as compared with the West Coast grade, which in some districts is 5s. to 5s. 6d. per ton dearer than the Cleveland iron. Heavy deliveries of the latter are still being made to Sheffield and the Midlands, and one or two cargoes have also been shipped to Italy. The minimum home price of No. 1 East Coast hematite is 68s. per ton delivered Middlesbrough, delivered prices to other destinations being:—Yorkshire, 74s. to 77s.; Scotland, 75s.; Lancashire, 76s.; Birmingham, 79s.

LANCASHIRE.—New orders for pig-iron from this area are very slow in materialising. Foundries are allowing their present contracts to expire almost completely before entering into renewals, as it is generally believed that there is little prospect of any early price changes. For delivery to users in the Lancashire zone, Derbyshire, Staffordshire and North-East Coast brands of No. 3 foundry are all on offer on the basis of 74s. per ton, with Northamptonshire at 72s. 6d., Scottish No. 3 at from 82s. 6d. to 83s., West Coast hematite at round 80s. 6d., and East Coast material at 76s. for No. 1 and 75s. for No. 3, both unbroken.

MIDLANDS.—The light-castings foundries in this area continue to be very active; some have been in the position of having to turn away work. The general-engineering foundries, however, are not so busy, although those engaged in the electric, oil-engine and marine-engine trades are reasonably well employed. The zone prices for Midland brands of pig-iron remain unchanged. These are, for No. 3 grade, 67s. 6d. for Northants and 71s. for Derbyshire, Lincolnshire and Staffordshire, delivered to Birmingham and Black Country stations, and subject to a small rebate to large consumers. Quotations for the better qualities of iron keep steady. Scottish iron comes into the district in steady quantities at about 85s. to 87s. 6d., according to grade. Medium-phosphorus irons can be obtained at about 75s. to 80s., and special refined pig-irons from £5 10s. to £6 17s. 6d.

SCOTLAND.—There has been little demand for Scottish pig-iron, and the official minimum of 70s. for No. 3 foundry is still in force, with 2s. 6d. per ton extra for No. 1, at furnaces. Business in the light-castings trade remains good, and prospects for the autumn are distinctly favourable. Cleveland No. 3 continues to be quoted at 67s. 3d. f.o.r. Falkirk and 70s. 3d. f.o.r. Glasgow.

Coke

Conditions in the foundry-coke market remain quiet but firm. There has been little change in prices. Quotations for delivery in the Birmingham area are as follow:—Best Durham coke, 36s. to 40s.; other grades, down to 35s.; Welsh coke, 37s. 6d. to 45s., according to grade; best Scottish coke, 40s. to 41s. per ton.

Steel

There has been little movement in the steel markets since the Bank Holiday break, and no important increase in the demand is expected until the end of the month, states the official report of the London Iron and Steel Exchange. The usual autumn revival in business should make itself felt early this year, as for some time consumers and stockholders have been confining their purchases to material for near delivery. This is taken as an indication that stocks are low, and buying on a more generous scale for replenishment is expected shortly. Some improvement is noticeable in the semi-finished steel department, although the orders reaching the works are still on the small side. The position in this branch of the industry, however, is regarded as satisfactory, in spite of the competition of cheap imported steel from the Continent. Business in finished steel has been dull in sympathy with conditions in other departments of the market. The works, however, are well provided with orders, and recently there has been an encouraging amount of inquiry in circulation. A slight improvement has also taken place in the export markets, but the bulk of the orders reaching the works is on home account.

Scrap

Rather firmer conditions have prevailed in the scrap-iron market. In the Cleveland area, heavy metal is quoted at 50s. per ton and good machinery grade at 52s. 6d., but light metal is rather a drug on the market and might be bought below the quoted price of 42s. per ton. The market remains firm in the Midlands, quotations being 55s. for heavy machinery scrap, 50s. for good heavy and 47s. 6d. for clean light, delivered works. The demand for scrap iron in South Wales is limited, and the market has continued sluggish. In Scotland, machinery cast-iron scrap, suitable for foundries, is quoted at 54s. to 55s. with ordinary cast iron to the same specification at 51s. 3d. to 52s. 6d.

Metals

Copper.—Trade with consumers of this metal has been on the quiet side since the holiday. The Continental demand has also been limited. Very little copper has been sold to Germany since the base-metal industries in that country came under Governmental control, only a few parcels being imported now and again. American producers have lately increased their selling pressure on the London market, and competition from this quarter will be further intensified if there is any fall in the exchange value of the dollar. As it is, prices have remained at a very low level for the past week or so.

Daily market prices:—

Cash.—Thursday, £28 13s. 9d. to £28 15s.; Friday, £28 15s. to £28 16s. 3d.; Monday, £28 12s. 6d. to £28 13s. 9d.; Tuesday, £28 15s. to £28 16s. 3d.; Wednesday, £28 7s. 6d. to £28 10s.

Three Months.—Thursday, £29 1s. 3d. to £29 2s. 6d.; Friday, £29 2s. 6d. to £29 3s. 9d.; Monday, £29 to £29 1s. 3d.; Tuesday, £29 2s. 6d. to £29 3s. 9d.; Wednesday, £28 16s. 3d. to £28 17s. 6d.

Tin.—The price of this metal showed a fluctuating tendency during the past week, in accordance with rumours as to the probable outcome of Monday's meeting of the Tin Committee, which is referred to below. The industrial demand for tin in this country has been dull, and similar conditions rule on the Continent. A rather more active demand is reported from America, however, where beef canning has lately been intensified by the drought.

At its monthly meeting, held in London on Monday, the International Tin Committee decided to reduce the tin output quota from the present 50 per cent. of standard tonnage to 40 per cent. during the period from October 1 to December 31, 1934. This decision is stated to have been brought about by the sharp fall in world demand during recent weeks. Since the news of the cut became known, the tin market has strengthened considerably, and prices have already risen sharply.

Price fluctuations:—

Cash.—Thursday, £228 17s. 6d. to £229; Friday, £227 15s. to £228; Monday, £228 15s. to £229; Tuesday, £230 12s. 6d. to £230 15s.; Wednesday, £229 15s. to £229 17s. 6d.

Three Months.—Thursday, £228 17s. 6d. to £229; Friday, £227 15s. to £228; Monday, £228 15s. to £229; Tuesday, £230 15s. to £230 17s. 6d.; Wednesday, £229 15s. to £229 17s. 6d.

Spelter.—There has been a seasonal falling-off in the demand for spelter, and a period of quiet trading is expected to continue for some little while. The galvanising branches are none too well occupied, but the brass trades still remain fairly active.

Day-to-day quotations:—

Ordinary.—Thursday, £13 12s. 6d.; Friday, £13 12s. 6d.; Monday, £13 10s.; Tuesday, £13 11s. 3d.; Wednesday, £13 13s. 9d.

Lead.—"Trade demand in this country is well sustained and the market has been fairly well supported, and, as offerings at no time have been unduly heavy, values have been on the whole very well maintained. Arrivals continue heavy in this country and an active business has been transacted again for August shipment, but offerings have been well absorbed," report Messrs. Rudolf Wolff.

Price fluctuations have been as follow:—

Soft Foreign (Prompt).—Thursday, £10 17s. 6d.; Friday, £11 2s. 6d.; Monday, £11; Tuesday, £10 18s. 9d.; Wednesday, £10 17s. 6d.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

27,285. BRITISH FURNACES, LTD., and HOPKINSON, P. Combustion of fuel gas for the heat-treatment of materials, such as steel. 407,744.

26,171. CARRINGTON, F. G. Manufacture of cast-metal pipes and like articles centrifugally. 407,886.

24,565. BRASSERT & CO., LTD., H. A., and MILES, J. Gates for the runners of blast and like metal-smelting furnaces. 408,206.

31,640. SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Process for deoxidising Steel. 408,253.

31,641. SOC. D'ELECTRO-CHIMIE, D'ELECTRO-METALLURGIE, ET DES ACIERIES ELECTRIQUES D'UGINE. Process for dephosphorising steel. 408,254.

25,277. MANUEL, J., and PILLANS, R. N. A. Manufacture of bolts and the like. 408,573.

23,435. SCHIFFLER, H. J. Steel for hydrogen reaction chambers. 408,632.

8,888. BREARLEY, A. W., and BREARLEY, H. Cores and moulds for ingots and other heavy castings. 408,798.

14,102. MURAKAMI, Y. Method and apparatus for manufacturing metallic materials by rotating the rolls or wheels containing a molten metal between them. 408,820.

15,095. STEWARTS AND LLOYDS, LTD., and DUNN, W. W. Manufacture of corrugated pipes and creased or corrugated pipe bends. 408,825.

16,207. TOUSSAINT, H., and BOCHUMER EISENHUTTE HEINTZMANN & CO., GES. Profiled iron. 408,828.

19,555. FREELAND, E. M. Treatment of iron-silicon alloys and the metal resulting therefrom. 408,949.

28,923. TIMMINS, D. Metal-melting furnaces. 408,960.

29,003. WISE, G. A. Plant for rolling and finishing round rods. 409,000.

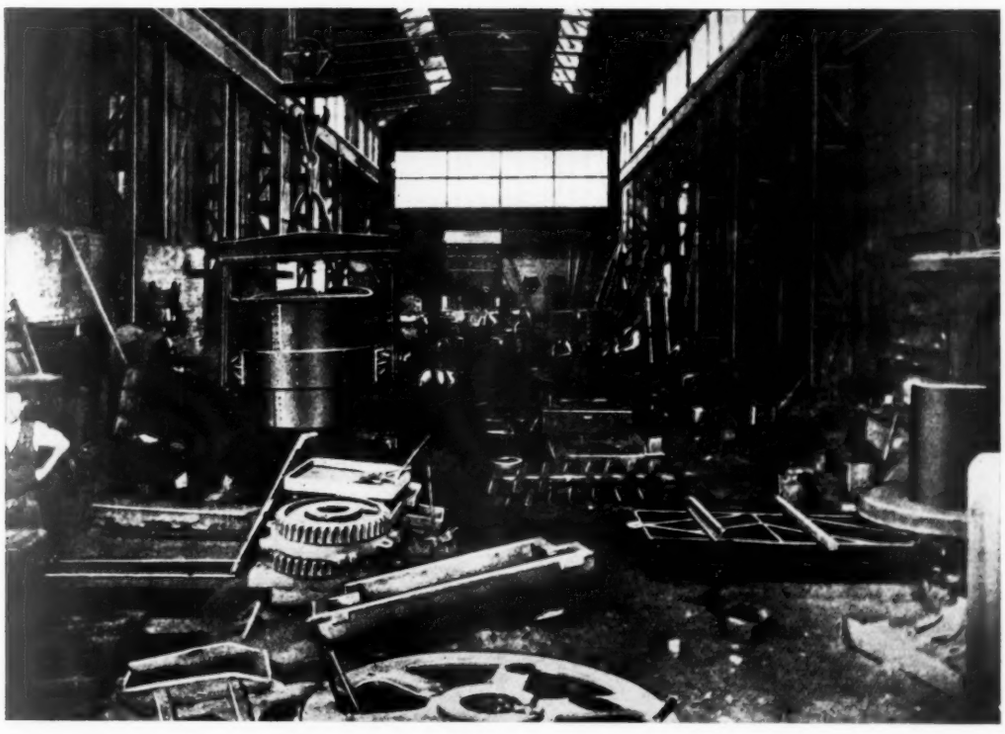
30,150. WEBB, A. W. OGILVY. Furnace apparatus for the heat-treatment of metallic or other bodies. 409,034.

Round Tensile Bars for Cast Iron

(*Concluded from page* 101.)

Under some circumstances the tensile-test value obtained varies as the plastic character of the iron varies. As the plastic factor can be determined quantitatively by bending tests or on a tensile bar using extensometers, the opinion is expressed that it is undesirable to use short, thick bars for tensile-strength determinations of cast iron.

BRITISH ROLL FOUNDRIES



One of the ROLL FOUNDRIES of RICHARD NEVILL & CO., LTD., LLANELLY, users of—

GENUINE
COLD BLAST PIG IRON

The continued use of Genuine Cold Blast Pig Iron, despite modern innovations, is a certain proof that it possesses properties not to be found to the same high degree in any other Pig Iron. This superiority lies chiefly in its remarkable homogeneity, greater strength and better wearing qualities, which are not lost on remelting in the cupola or air furnace, but persist right through to the castings made.

THE GENUINE COLD BLAST PIG IRONS: DUD · L.N.F'ces · DUD LOWMOOR C.B. GRAZEBROOK

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.
BRIERLEY HILL, STAFFS.
Brand: "DUD·L.N.F'ces·DUD"

M. & W. GRAZEBROOK, LIMITED
DUDLEY, WORCS.
Brand: "GRAZEBROOK"

THE LOW MOOR IRON CO., LTD.,
NEW WORKS, LOW MOOR, BRADFORD - YORKSHIRE
Brand: "LOWMOOR C.B."

RAW MATERIALS—PRICE LIST

(Wednesday, August 15, 1934)

COPPER

	£	s.	d.
Standard cash	28	7	6
Three months	28	16	3
Electrolytic	31	10	0
Tough	30	10	0
Best selected	31	0	0
Sheets	58	0	0
India	41	0	0
Wire bars	31	15	0
Ingot bars	31	15	0
H.C. wire rods	34	5	0
Off. av. cash, July	29	15	0
Do., 3 mths., July	30	2	1 1/10
Do., Sttlmnt., July	29	15	0
Do., Electro, July	33	0	0
Do., B.S., July	32	13	0 2/5
Do., wire bars, July	33	4	5 2/11
Solid drawn tubes			9 1/2d.
Brazed tubes			9 1/2d.
Wire			6 1/4d.

BRASS

Solid drawn tubes	8 3/4d.
Brazed tubes	10 1/2d.
Rods, drawn	8 1/2d.
Rods, extd. or rlld.	4 1/2d.
Sheets to 10 w.g.	7d.
Wire	7 1/2d.
Rolled metal	6 1/2d.
Yellow metal rods	4 1/2d.
Do. 4 × 4 Squares	5 1/2d.
Do. 4 × 3 Sheets	5 1/2d.

TIN

	£	s.	d.
Standard cash	229	15	0
Three months	229	15	0
English	229	17	6
Bars	232	2	6
Straits	230	0	0
Australian (nom.)		—	
Eastern	230	10	0
Banca	230	12	6
Off. av. cash, July	230	9	3 9/11
Do., 3 mths., July	230	1	5 8/11
Do., Sttlmt., July	230	8	10 8/11

SPELTER

	£	s.	d.
Ordinary	13	13	9
Remelted	14	5	0
Hard	11	5	0
Electro 99.9	16	5	0
English	14	5	0
India	13	5	0
Zinc dust	16	10	0
Zinc ashes	3	0	0
Off. aver., July	13	11	7 1/11
Aver. spot, July	13	9	3 9/11

LEAD

	£	s.	d.
Soft foreign ppt.	10	17	6
Empire (nom.)	11	13	9
English	12	15	0
Off. average, July	10	18	6 5/22
Average spot, July	10	16	3

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	5	0
Do., V.M. ex whse.	21	12	6
Rods	27	10	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	43	0	0 to	45	0	0
Chinese, ex-whse.				37	10	0
Crude					—	

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	11	2	6 to	11	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 7 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	5/6 lb. Mo.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/- lb.
Tungsten metal powder—	
98/99%	3/3 lb.
Ferro-chrome—	
2/4% car.	£29 15 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70%, carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 0d.
Finished bars, 18% tungsten 2s. 9d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under 1/8 in. to 1/4 in. 3d. lb.
Do., under 1/4 in. to 1/16 in. 1/- lb.
Flats, 1/8 in. × 1/4 in. to under 1 in. × 1/8 in. 3d. lb.
Do., under 1/4 in. × 1/4 in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	13	0 to	2	15	0
Bundled shrngs.	2	7	0 to	2	8	0
Mixed iron and steel	2	8	0 to	2	10	0
Heavy cast iron	2	5	0 to	2	7	6
Good machinery	2	10	0 to	2	12	6
Cleveland—						
Heavy steel				2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	10	0 to	2	12	6
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	12	6
Scotland—						
Heavy steel	2	10	0 to	2	11	3
Ordinary cast iron	2	11	3 to	2	12	6
Engineers' turnings				2	0	0
Cast-iron borings	1	19	0 to	2	0	0
Wrought-iron piling	2	10	0 to	2	11	3
Heavy machinery	2	14	0 to	2	15	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	25	0	0
Brass	17	10	0
Lead (less usual draft)	9	10	0
Tea lead	7	0	0
Zinc	9	0	0
New aluminium cuttings	69	0	0
Braziery copper	22	0	0
Gunmetal	23	0	0
Hollow pewter	145	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	70/-
Foundry No. 3	57/6
„ at Falkirk	67/3
„ at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6

N.W. Coast—

Hem. M/Nos. d/d Glas.	72/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	67/-
„ No. 3 fdry.	71/-
Northants forge	63/6
„ fdry. No. 3	67/6
„ fdry. No. 1	70/6
Derbyshire forge	67/-
„ fdry. No. 3	71/-
„ fdry. No. 1	74/-

Scotland—

Foundry No. 1, f.o.t.	72/6
„ No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-

Sheffield (d/d district)—

Derby forge	64/6
„ fdry. No. 3	68/6
Lincs forge	64/6
„ fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	10	0 to	8	0	0
Hoops	10	10	0 and up.			
Marked bars (Staffs) f.o.t.			12	0	0	
Gas strip	10	10	0 and up.			
Bolts and nuts, 3/4 in. × 4 in.			14	0	0	
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	0	0 to	8	10	0
Chequer plts.			10	7	6	
Angles			8	7	6	
Tees			9	7	6	
Joists			8	15	0	
Rounds and squares, 3 in. to 5 1/2 in.			9	7	6	
Rounds under 3 in. to 1/8 in. (Untested)			8	12	0	
Flats—8 in. wide and over			8	12	6	
„ under 8 in. and over 5 in.			8	17	6	
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)			9	7	0	
Black sheets, 24g. (4-t. lots)			10	10	0	
Galv. cor. shts. („)			13	0	0	
Galv. flat shts. („)			13	10	0	
Galv. fencing wire, 8g. plain			14	10	0	
Billets, soft			5	10	0	
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	7	6
Tin bars	5	2	6 to	5	7	6

PHOSPHOR BRONZE

	Per lb. basis.
Strip	9d.
Sheet to 10 w.g.	10d.
Wire	11 1/2d.
Rods	10d.
Tubes	13d.
Castings	11d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1 1/2 to 1/7 1/2
To 15 in. wide	1/1 1/2 to 1/7 1/2
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2 1/2 to 1/8 1/2
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3 1/2
Ingots rolled to spoon size	10d. to 1/6 1/2
Wire round—	
to 10g.	1/4 1/2 to 1/11 1/2

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3 1/2 upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.25
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37 1/2
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
„ furnace	20/-
Durham foundry	21/- to 25/-
„ furnace	17/6
Midlands, foundry	—
„ furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20 × 14	per box	18/-
„	28 × 20	„	36/-
„	20 × 10	„	26/-
„	18 3/4 × 14	„	18/7 1/2
C.W.	20 × 14	„	15/9
„	28 × 20	„	33/3
„	20 × 10	„	22/6
„	18 3/4 × 14	„	15/9

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	6	0	0 to	7	0	0
Bars-hammered, basis	16	0	0 to	16	10	0
Bars and nail-rods, rolled, basis	15	15	0 to	16	0	0
Blooms	10	0	0 to	12	0	0
Keg steel	30	0	0 to	31	0	0
Faggot steel	18	0	0 to	23	0	0
Bars and rods dead soft, st'l	10	0	0 to	12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.		
Aug.	9 ..	28	13	9	inc.	1/3
,,	10 ..	28	15	0	,,	1/3
,,	13 ..	28	12	6	dec.	2/6
,,	14 ..	28	15	0	inc.	2/6
,,	15 ..	28	7	6	dec.	7/6

Electrolytic Copper

		£	s.	d.		
Aug.	9 ..	31	15	0	No	change
,,	10 ..	31	15	0	,,	,,
,,	13 ..	31	15	0	,,	,,
,,	14 ..	32	0	0	inc.	5/–
,,	15 ..	31	10	0	dec.	10/–

Standard Tin (cash)

		£	s.	d.		
Aug.	9 ..	228	17	6	inc.	32/6
,,	10 ..	227	15	0	dec.	22/6
,,	13 ..	228	15	0	inc.	20/–
,,	14 ..	230	12	6	,,	37/6
,,	15 ..	229	15	0	dec.	17/6

Tin (English ingots)

		£	s.	d.		
Aug.	9 ..	229	2	6	inc.	30/–
,,	10 ..	228	2	6	dec.	20/–
,,	13 ..	229	2	6	inc.	20/–
,,	14 ..	230	15	0	,,	32/6
,,	15 ..	229	15	0	dec.	20/–

Spelter (ordinary)

		£	s.	d.		
Aug.	9 ..	13	12	6	inc.	1/3
,,	10 ..	13	12	6	No	change
,,	13 ..	13	10	0	dec.	2/6
,,	14 ..	13	11	3	inc.	1/3
,,	15 ..	13	13	9	,,	2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Aug.	9 ..	16	3	9	inc.	1/3
,,	10 ..	16	5	0	,,	1/3
,,	13 ..	16	2	6	dec.	2/6
,,	14 ..	16	5	0	inc.	2/6
,,	15 ..	16	5	0	No	change

Zinc Sheets (English)

		£	s.	d.		
Aug.	9 ..	23	5	0	No	change
,,	10 ..	23	5	0	,,	,,
,,	13 ..	23	5	0	,,	,,
,,	14 ..	23	5	0	,,	,,
,,	15 ..	23	5	0	,,	,,

Lead (English)

		£	s.	d.		
Aug.	9 ..	12	10	0	No	change
,,	10 ..	12	15	0	inc.	5/–
,,	13 ..	12	15	0	No	change
,,	14 ..	12	15	0	,,	,,
,,	15 ..	12	15	0	,,	,,

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1900	10 0 0	10 10 0	10 10 0	10 10 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	9 10 0	8 15 0	8 15 0	10 1 3
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11½
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	6 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 8 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11½	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6	12 4 6	11 18 6	11 13 9	11 13 0	12 6 2½
1926	11 7 9½	11 5 0	11 5 0	11 5 0	11 3 9	11 3 9	11 5 0	12 0 0	13 0 0	*	15 7 6	12 19 0	12 0 2
1927	12 6 3	12 2 6	11 14 0	11 0 0	10 18 9	10 13 6	10 12 6	10 5 0	9 16 0	9 15 0	9 13 9	9 12 9	10 14 2
1928	9 12 6	9 12 6	9 11 0	9 10 0	9 8 4	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 3 6	9 1 3	9 7 0
1929	9 0 0	9 2 6	9 5 7½	9 9 4½	9 10 0	9 17 6	10 2 6	10 2 6	10 2 6	10 0 6	10 3 9	10 5 7	9 15 2½
1930	10 7 6	10 7 6	10 7 6	10 6 10½	10 6 3	10 5 0	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 2 6	10 4 7½
1931	10 2 6	10 0 0	10 0 0	10 0 0	9 18 1½	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 17 6	9 16 10½	9 18 0½
1932	9 15 0	9 15 0	9 15 0	9 15 0	9 13 9	9 11 3	9 10 0	9 10 0	9 10 0	9 6 3	9 5 0	9 5 0	9 10 11½
1933	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0
1934	9 5 0	9 8 1½	9 12 6	9 12 6	9 12 6	9 12 6	9 12 6	—	—	—	—	—	—

* No quotation available owing to strike.

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FOUNDRY Manager or Foreman.—Advertiser desires similar position; age 45; experience iron and non-ferrous, repetition and jobbing, motor, electrical and engineering castings; expert on machine-moulding methods; energetic and keen disciplinarian; take complete control; nominal salary plus payment on results.—Box 844, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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FOR SALE BY PRIVATE TREATY, WITH POSSESSION ON COMPLETION,

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This Week's Bargains

Complete Plant comprising the following :—Re-conditioned.

2 Sand-blast Rooms, 6 ft. x 6 ft. x 8 ft. 3 in. high (could use as one room).
2 Sand-blast Apparatus of our very latest totally-enclosed type.
1 Vertical Air Compressor, 400 cub. ft., direct-coupled on bedplate to Motor, 50 h.p., 3-phase, 50 cycles, 400 volts, and Starter.
1 Air Receiver, 3 ft. 6 in. dia. x 8 ft. high.
1 Extra Strong Exhaust Fan, complete with 25-h.p. Motor and Starter.
1 Latest Type Tilghman Dust Arrester, 10 ft. x 8 ft. 4 in. x 6 ft. 4 in.

R. J. RICHARDSON & SONS, LTD.,
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MISCELLANEOUS

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'Phone: 287 SLOUGH

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Herbert "Whizzer" type disintegrator, No. 1 **£30**
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Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

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